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The Role of Quality In Soybean Import Decisionmaking

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The Role of Quality in Soybean Import Decisionmaking. By Stephanie A. Mercier and Brian Gohlke. Commercial Agriculture Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 722.

Abstract

U.S. soybean and soybean meal exports have experienced considerable competitive pressure from South American exports in the last decade. The recent decline in the U.S. share has renewed interest in determining whether cleaner soybeans would help the competitiveness of the U.S. soybean sector. Mandating cleaner soybeans under current production and marketing practices would have a minor effect on the market share or value of U.S. soybean exports. Soybean crushers, who dominate imports of soybeans, are largely concerned about relative prices between oilseeds and meals and their oil and protein content, though cleanliness does play a secondary role in the decisionmaking process.

Keywords: World soybean trade, soybean products, grain quality, foreign material, import decisionmaking, end-use characteristics, market segmentation

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Foreword

This report is a product of the International Grain Quality Project conducted jointly by the Agriculture and Trade Analysis and Commodity Economics Divisions of the Economic Research Service, which in late 1994 were consolidated into the Commercial Agriculture Division. This report concentrates on the role of quality in the international soybean market. Other reports have examined the same issue for the world wheat and corn markets.

The main source of information for this report is a series of case studies on the soybean and oilseed markets and import decisionmaking in 11 countries. The original case studies are available, upon request, from the individual authors. Countries covered and study participants are as follows:

Indonesia--Stephen S. Magiera
Italy--Daniel J. Plunkett
Japan--Alan J. Webb
Mexico--Constanza M. Valdes and Mark S. Ash
The Netherlands--Mary Ann Normile and Mildred Haley
Poland--Linwood Hoffman
Russia--Sharon S. Sheffield and Roger Hoskin
South Korea--Nancy Morgan and Terri Raney
Spain--Mildred Haley and Mary Anne Normile
Taiwan--Sophia Wu Huang and William Lin
Venezuela--Parveen Setia and Erin M. Dusch

All working papers listed above are available from the Economic Research Service.

Contents

Summary

Mandating cleaner soybeans, under current production and marketing practices, would have a minor effect on the market share or value of U.S. exports.

This report examines the market structure and import decisionmaking process in key soybean-importing countries. Buyers in major importing countries had only limited interest in paying more for U.S. soybeans with greater cleanliness, or increasing imports of U.S. soybeans, largely because of the availability of lower priced, higher quality beans from Brazil. Many buy U.S. soybeans only when competitor beans are no longer available.

Soybean importers choose among suppliers based on a number of factors, including price, quality, trade-servicing reliability, transportation costs and convenience, the availability of export credit, and intergovernmental relations. The chief factors affecting quality from the exporter side appear to be the handling practices, climate, soybean genotypes, and the relative incentives between yield and quality created by government policies.

Most of the countries studied import soybeans primarily for crushing. A few import substantial amounts for food processing, where it serves as a food staple. Each of those markets react differently to soybean quality, which includes cleanliness, and protein and oil content.

For most of the markets that import predominantly for feed use, soybean quality is considered secondary to price (though closely related) in import decisionmaking. Those markets that import for food use screen potential sources primarily on the basis of quality, then pick between them based largely on price.

Cleanliness ranks high among quality factors listed by both feed manufacturers and food processors, although for somewhat different reasons. Cleanliness is a concern to feed compounders because it detracts from grain storability. Cleanliness is a concern for food manufacturers because foreign matter can act as a contaminant. But of more concern to food processors are intrinsic characteristics of the kernel, such as carbohydrate content, bean color and size, and sugar content.

Despite these concerns, the opportunity to purchase cleaner U.S. soybeans provoked very little response among major importers for the following reasons: (1) those interested in cleaner soybeans for crushing can buy them from Brazil and Argentina during part of the year without paying a higher price, (2) U.S. soybeans maintain the largest share of the soybean export market, due to U.S. production volume and storage and shipping advantages, and (3) most crushers are familiar with the level of foreign matter in U.S. soybeans and have learned to deal with it.

It seems likely that the United States could generate a more clear-cut response from importers by paying more attention to the oil and protein yields of U.S. soybeans and even to the composition of that protein and oil through conventional plant breeding and genetic engineering techniques.

The Role of Quality in Soybean Import Decisionmaking

Stephanie A. Mercier
Brian Gohlke

Introduction

The quality of U.S. grain has been a matter of public debate since the mid-19th century, and the U.S. Grain Standards Act mandating the creation of the first set of uniform grain standards which dates back to 1916 was an early result of this debate (Hill, 1990).[1] Similar standards for oilseeds were implemented in 1924. For soybeans, quality, macroeconomic factors, and domestic and foreign commodity policies have been emphasized in discussions about U.S. competitiveness in the world market which stem from the recent decline in U.S. soybean market share.

Title XX (Grain Quality) of the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA) outlined the steps that the U.S. Department of Agriculture must take to determine if "establishing or amending the standards would...enhance the competitiveness of exports of wheat, corn, barley, sorghum, and soybeans from the United States." The title also instructed the Administrator of the Federal Grain Inspection Service (FGIS) to revise and, if necessary, establish standards that include "economically and commercially practical levels of cleanliness" if it is shown that the benefits outweigh the costs of imposing such standards, if other conditions specified in the title are also met. Cleanliness in this study refers particularly to the amount of *foreign material* (FM) in U.S. soybeans.[2]

This study assesses whether additional cleaning of soybeans would help maintain or even increase the U.S. soybean export market share, and whether cleaner soybeans would increase export receipts enough to offset domestic net cleaning costs. This report also identifies the major participants in the import decisionmaking process, what factors are considered in importers' purchase decisions, and the full range of quality factors considered by soybean importers. The role of cleanliness is considered within the overall purchase decision framework. This study examines several sources for the loss of U.S. soybean market share: (1) other exporters may consistently offer a lower price, (2) competing exporters may offer better credit terms, or (3) the shift in purchasing patterns might stem from perceived or actual quality differences among the various export sources. Other factors could include changing consumer tastes, government policies in importing or exporting countries, or trade pacts.

The foundation of this study is a series of case studies in which the market structures and import decisionmaking processes of 11 key soybean-importing countries were examined. Soybean quality concerns were placed in a world market context consisting of interrelated meal and oil demand linked to beans through the crushing process, and a small segment of soybean demand for food use. Soybean quality data collected both within and outside the country studies were examined to provide supporting evidence for the market relationships and trade strategies observed in this study.

Background

While the United States continues to dominate the world soybean market, U.S. exporters have faced increased

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[1] Names in parentheses refer to sources listed in the references at the end of this report.
[2] Italicized terms are defined in the glossary.

competitive pressure over the last decade, particularly in soybean product trade. The U.S. share of the world soybean market fell by nearly 30 percentage points from 1972 to 1994 (fig. 1). The decline in share was even more steep in the world soymeal market, more than 35 percentage points. Macroeconomic conditions, such as the strong dollar in the early 1980's, and the high corn target price, which discouraged U.S. soybean production, and the soybean loan rate, which provided a floor to world prices, combined to give Argentina and Brazil incentives to expand soybean production and trade during that period. Given the number and diversity of countries that commonly import soybeans or soybean products (at least 80 countries imported some soybeans or soymeal in 1992), it is likely that a mix of quality, price, aspects of supply reliability, and political factors are all considered in import decisions. Previous studies suggest that quality does play a role in such decisions for grain imports (U.S. Congress).

While the mandate for this study contained in Title XX of the 1990 FACTA focuses the soybean quality issue very narrowly on the degree of cleanliness (that is, level of FM), cleanliness is only one of many quality attributes of concern to buyers. Perceived deficiencies in end-use or intrinsic characteristics (see table 1) and uniformity between and within export shipments have been noted as quality issues in previous studies (U.S. Congress). Other aspects of quality (including physical factors and wholesomeness) were also examined. Soybean quality is usually viewed as a complex issue, but much of the focus has been on FM because it is a factor which is easily measured and for which the technical capability for removal prior to export exists.

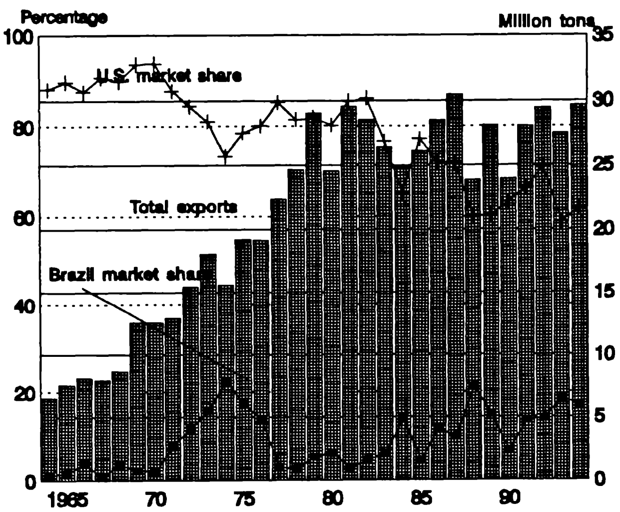
This study is a complement to a report on domestic costs and benefits of additional soybean cleaning (Lin and Hyberg, forthcoming). The domestic study evaluates the costs of cleaning U.S. soybeans to meet tighter standards and also the domestic benefits from selling lower-FM soybeans. That study concludes that cleaning U.S. export soybeans to a lower FM level (1 percent) is not economically feasible at current market premiums or discounts unless gains from increases in U.S. export price or trade offset the net cost of added cleaning, which is at least $26 million.

Brief Description of Study

The first section, the "World Soybean and Oilseed Market," describes the world market setting, including the submarkets for meal, oil, and food use. It briefly discusses the practices, policies, and regulations in soybean-exporting countries that affect the quality of soybeans available for export. This section highlights the relevant factors affecting quality in U.S. soybeans and those of other major exporters, Brazil, Argentina, and China. Extensive use is made of a previous study conducted by the Office of Technology Assessment in 1989 (U.S. Congress).

The second section of this study, "Importers and Import Decisionmaking," reports on individual case studies for 11 countries that currently import soybeans or soymeal (table

Figure 1
U.S. and Brazilian share of world soybean trade, 1964-94



Source: USDA/FAS, Sept. 1994

Table 1--Major soybean quality characteristics

Physical	Wholesomeness	Intrinsic
Foreign material	Live insects	Oil content
Split beans	Insect damage	Protein content
Heat-damaged beans	Toxic weed seeds	Breakage susceptibility
Mold-damaged beans	Pesticide residues	*Free-fatty acids*
Moisture content	Odor	Color[1]
Total damaged kernels[2]	Fungi	Fiber content
Test weight		
Kernel size		

[1]Relates to maturity of soybeans, but is also affected by weather and soil types. [2]Includes soybeans and pieces of soybeans which are heat-damaged, sprouted, frosted, badly ground damaged, badly weather damaged, moldy, diseased, stink-bug eaten, or otherwise materially damaged.

2). The countries were selected to represent a cross-section of major importers of soybeans. These studies consist of background material gathered on each country's soybean and soybean products market. This section draws heavily on both qualitative and quantitative information gathered in the separate country studies, as well as on previous background research. This section examines the major components of soybean demand--crush demand (meal) and food use. Where oil demand is a key determinant of purchasing behavior, that demand is also examined. This section examines the major players in the import decision and is organized around a two-stage purchasing procedure (similar to a standard budgeting process): the first stage focuses on how a country's total soybean (or oilseed) import needs are established, and the second stage examines how the country selects its sources of oilseeds or oilseed products, including the general role of quality and the specific role of foreign material.

The third section, "Comparisons of U.S. Soybean Performance and Importers' Needs," examines aggregate U.S. soybean quality shifts and their implications for the U.S. market. The scope of competition for world market share is explored, and the effect of cleanliness on U.S. export demand for soybeans is evaluated, along with potential responses by competitors.

The World Soybean and Oilseed Market

Soybeans and soybean products dominate world trade of protein-rich oilseeds and meals. Over the last 5 years, soybean production alone has accounted for just under half of total world oilseed production, while the next largest, cottonseed, accounted for only 15 percent of world production (fig. 2 and appendix table 3). Other major oilseeds include rapeseed, sunflowerseed, and peanuts. The role of soybeans and soymeal is even more commanding in the world market, holding more than 70 percent of world trade in oilseeds and oilseed meals over the same period (U.S. Department of Agriculture, Foreign Agricultural Service (USDA/FAS)). While soybeans have multiple end-uses, the majority of soybeans produced are crushed into meal for use in livestock feed and oil in food and industrial products. Use of soybeans as a food is limited, occurring mainly in East Asia where the bean was first cultivated. In those countries, soybean food products serve as protein sources in some diets.

Table 2--Countries featured in individual case studies

Country	Country	Country
Indonesia	The Netherlands	Spain
Italy	Poland[1]	Taiwan
Japan	Russia	Venezuela
Mexico	South Korea	

[1]No U.S. soybeans have been directly imported into Poland in the last few years, although odd lots have been purchased on European spot markets.

The World Soybean Market

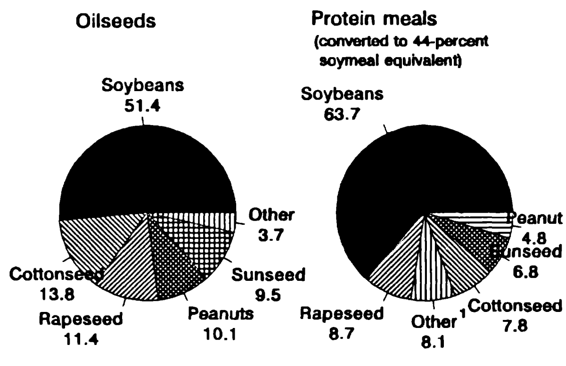
Total soybean production averaged about 108 million tons over the last few years (1989-92). However, more than 75 percent of the production and about 85 percent of the exports come from three Western Hemisphere countries: the United States, Brazil, and Argentina (table 3). China, Italy, and Paraguay also produce a significant amount of soybeans, but export relatively few raw soybeans. Soybeans crushed into oil and meal account for nearly 85 percent of world soybean demand. The remaining 15 percent is either fed directly (as whole-cooked or *full-fat beans*) to livestock or used for food or industrial products.

The Oil and Protein Meal Markets

Soybeans are the most common crop grown for vegetable oil and protein meal for many reasons. Soybean profits per acre are usually comparable with profits from grain cultivation in climates with desirable soil characteristics and abundant rainfall. Soybeans tend to be rotated with cereal crops for the purpose of replenishing soil nitrogen and breaking pest and disease cycles, hence reducing chemical input costs. Yields per acre for soybeans are generally higher than other oilseeds under similar growing

Figure 2

Soybeans as share of world oilseed and protein meal production, 1988/89-1992/93 average



Note: Number represents percentage share.
[1]Also includes fish meal.

Table 3--Major soybean exporters: production and exports, 1988/89-1992/93

Country	1988/89	1989/90	1990/91	1991/92	1992/93	Share of output exported[1]
	Million metric tons					*Percent*
Production:						
United States	42.15	52.35	52.42	54.07	59.55	33.0
Brazil	23.20	20.34	15.75	19.30	22.30	19.1
China	11.65	10.23	11.00	9.71	10.30	8.9
Argentina	6.50	10.75	11.50	11.15	11.00	25.9
Italy	1.41	1.62	1.75	1.32	1.05	0.0
Paraguay	1.62	1.58	1.30	1.30	1.75	94.9
Total	86.78	97.23	94.04	97.03	106.11	26.9
World	95.65	107.37	104.16	106.92	116.43	25.2

	1988/89	1989/90	1990/91	1991/92	1992/93	Five-year market share
	Million metric tons					*Percent*
Exports:						
United States	14.36	16.95	15.16	18.62	20.94	64.3
Brazil	4.84	3.93	2.48	3.87	4.02	14.4
Argentina	0.45	3.07	4.40	3.21	2.05	9.8
Paraguay	1.95	1.63	1.03	0.83	1.30	5.0
China	1.21	1.11	1.29	1.09	0.30	3.3
Total	22.80	26.68	24.43	27.62	28.61	96.6
World[2]	23.54	27.38	25.38	28.46	29.44	100.0

[1]Represents share of production exported between 1988/89 and 1992/93. [2]Figures include intra-EC trade. Source: USDA/FAS.

conditions. Soybeans also have a higher protein content than other oilseeds, about 80 percent extraction rate for protein meal compared with less than 60 percent for rapeseed. All these factors lead to favorable prices for soymeal in the world market relative to competing meals, since livestock demand and thus protein demand drives the oilseed market.

Product yields from a given lot of soybeans for oil and meal depend upon the biological tradeoff between the protein and oil content of the bean. Climatic conditions have a major impact on that relationship. A drier climate tends to produce soybeans with a higher protein content, while a moist climate will tend to have soybeans with a high oil content (Nichols, Clapp, and Perrin).

Soybean products make up 20 percent of the world vegetable oil market and 60 percent of the world protein meal market; therefore, soybean trade should be viewed in the context of the total oilseed and products market (table 4 and appendix table 4). Other crops whose meals compete with soymeal include sunflowerseed, rapeseed, cottonseed, peanut, and coconut. The oils of all of these crops as well as olive, palm, and palm kernel compete with soybean oil in the vegetable oil market.

A portion of the vegetable oil market is fairly stable because food manufacturers use ingredients and price formulas to produce food end-products. Such formulas typically call for specific amounts of several different refined oils in fixed and known proportions, to enhance

Table 4--Major soybean meal exporters: production and trade, 1988/89-1992/93

Country	1988/89	1989/90	1990/91	1991/92	1992/93	Share of output exported
	Million metric tons					*Percent*
Production:						
United States	22.63	25.15	25.70	27.06	27.55	20.9
Brazil	11.36	12.35	11.69	11.69	12.04	73.8
Argentina	4.85	5.05	5.67	6.22	6.82	97.2
China	3.57	3.02	3.28	2.85	3.28	44.6
Total	42.41	45.57	45.75	47.82	50.03	45.3
World	64.23	70.08	69.34	72.84	76.02	38.1
	1988/89	1989/90	1990/91	1991/92	1992/93	Five-year market share
	Million metric tons					*Percent*
Exports:						
United States	4.94	4.83	4.96	6.30	5.65	19.8
Brazil	8.68	9.43	8.23	8.86	7.98	32.1
Argentina	4.80	4.75	5.58	6.19	6.50	20.7
China	1.60	1.60	2.25	1.40	0.40	5.4
Total	20.02	20.61	21.02	22.75	20.53	78.0
World[1]	24.98	26.01	26.90	28.83	27.77	100.0

[1]Figures include intra-EC trade. Source: USDA/FAS.

product differentiation.[3] After formula demand has been satisfied, the rest of the refined oil demand can be met by any oil.

The choice of which oil is used by remaining outlets varies between countries and is based on relative prices, influenced both by local availability and domestic and trade policies. For example, in the EC, olive oil is a commonly used oil due to heavy subsidizing and strong consumer preferences for that type (although accounting for only 14 percent of EC consumption). Olive oil is a specialty product in the United States (accounting for less than 1 percent of consumption), while soy oil predominates because of the abundance of soybeans and the resulting low relative price of soy oil.

Market demand for oilseed meal comes largely from livestock and poultry producers who use it as a high-protein feed ingredient. Meal used depends in large part upon the cost of the meal varieties and the price of other competing livestock feed ingredients, limited by the nutrient and vitamin needs of the animal. However, soymeal is also nutritionally more balanced for most livestock types than other oilseed meals, and is characterized by a slightly higher protein content (Bickerton and Glauber). A higher proportion of protein is typically used in poultry rations than in pork and dairy cattle rations. Livestock producers will typically use a mixture of feed ingredients, which has a lower average price over a long period of time. For example, EC producers use rations with 20-25 percent protein meal because the costs of grains are higher due to generous EC grain support prices. Protein accounts for a large share of feed rations in Japan, Taiwan, and Venezuela because of restrictions on grain imports and heavy concentration in poultry feeding (table 5). On the other hand, protein meal

[3]The level of saturated fat in a given oil is often a consideration in its selection in food products.

Table 5--Soymeal and total meal use as share of total compound feeds, 1992/93 marketing year

Country	Total soymeal fed	Total meal fed	Total compound feeds[1]	Share of protein meal in compound feeds
	- - - - - - -*Thousand metric tons*- - - - - - -			*Percent*
Indonesia	300	798	3,728	21.4
Italy	3,105	3,930	14,839	28.5[2]
Japan	3,876	5,891	22,978	25.6
Mexico	2,570	3,067	12,789	23.9
The Netherlands	2,856	4,128	6,670	27.5[2]
Poland	652	1,022	11,587	8.8
Russia[3]	2,176	6,421	132,251	7.0
South Korea	1,446	2,533	10,764	20.6
Spain	3,205	4,288	17,625	26.5[2]
Taiwan	1,964	2,610	8,041	32.5
Venezuela	667	686	1,756	39.0

[1]Feed concentrates defined as total of feed grains and oilseed meals. For Spain, the Netherlands, and South Korea, this figure also includes about 2 million tons of nongrain feed ingredients, such as manioc, corn gluten feed, and *distillers' dried grains*. [2]For Italy, the Netherlands, and Spain, protein meals also include full-fat soybeans fed to livestock. [3]Figures for FSU-12. Source: USDA/FAS.

accounts for only 10-15 percent of the average U.S. feed ration because relative grain prices are lower (USDA/Agricultural Marketing Service).

Contrasts Between Major Exporters

Over the last few decades, fluctuations in trade volume have occurred in the world soybean and products market. Nevertheless, the general trend has been an increase in the amount of soybeans, soybean meal, and soy oil traded. The United States is the largest exporter of raw soybeans, accounting for over 60 percent of world soybean exports; however, this position shifts significantly when world processed soybean trade is considered. The United States is the third largest exporter of soybean meal, behind both Brazil and Argentina. These three countries together account for nearly 75 percent of world trade in soybean meal. Soybean oil exports are also dominated by the same countries, which control 60 percent of world trade.

Production and Marketing Systems

The handling and marketing practices and climates of major exporters are the greatest determinants of differing export soybean quality. The major soybean producers in the Western Hemisphere use similar soil preparation and cultivation practices and similar harvesting technology. China uses less modern farm technology, but has abundant farm labor, so much of the cultivation and harvesting is done manually by farmers who hold small plots (usually less than 1 hectare in size).

Soybeans grow best within a fairly narrow range of climatic conditions, though Brazilian soybeans generally receive more rainfall and experience warmer temperatures during the growing season than soybeans of the other three major exporters (USDA/World Agricultural Outlook Board). The Brazilian soil type also tends to differentiate their product. Red soil particles usually coat Brazilian soybeans when marketed for export, which can discolor resulting soybean oil.

The basic similarity in production practices in major soybean-exporting countries does not extend to handling and marketing practices. When the soybeans are harvested, farmers in each country store and transport the beans in a different manner. In the United States, storage and transportation facilities are located throughout the entire grain distribution system, creating a less seasonal export pattern. Even though this system creates a steady bean supply, which is an advantage for U.S. traders, it also tends to lead to more split beans and other types of breakage than is seen in Brazil or Argentina because of the number of times U.S. soybeans are handled.[4] For example, a farmer in the U.S. Midwest may harvest the crop, store it in an on-farm bin for some time, and then sell it to the local grain elevator. The country elevator may then store the soybeans for several weeks or months

[4]Excessive handling can increase split beans, FM, heat-damaged beans, mold damage, insect infestation, and damage to refined oil or protein quality. Storage can lead to high moisture and spoilage problems. Poor or obsolete harvest techniques can increase FM.

before shipping them to a Mississippi port elevator where the soybeans will be loaded on barges headed for New Orleans. After arriving at New Orleans, the soybeans are loaded on a cargo ship and exported. This suggests the beans are handled on six to eight separate occasions before being exported, which increases the probability of breakage to the beans. U.S. soybeans are typically stored for shorter periods than U.S. grains, whose producers have received government incentives for storage in some years.

In contrast, the transportation and marketing systems in Brazil and Argentina dictate less handling but these systems are also unable to provide a constant flow of beans into the world market. Argentine and Brazilian processors also prefer to manufacture meal in the form of pellets for easier transport.

In Brazil, handling and storage are coordinated by processing firms. Once the soybean crop is harvested, it is delivered immediately to the local elevator or directly to the processing plant by the farmers. Between 70 and 80 percent of annual production is sent to processors, so the main market channel is directed toward supplying these plants with their crush requirements. The Brazilian system does not possess the scale of on-farm storage and drying facilities that are available in the United States. Storage capacity within elevators and processing plants cannot handle the entire crop, which necessitates moving some beans for export during the harvesting months of April to August. During this 5-month period, over 75 percent of Brazilian soybean or soybean product exports occur. The soybeans are transported in trucks which may travel over 1,000 miles from the production areas in northern Brazil to the processors and ports in the south. This system permits less intermediate handling of the soybeans, but is also more costly.

The Argentine marketing channel is based around local elevators rather than processors, but its system is also characterized by a lack of storage facilities at the farm level. Thus, Argentine farmers rely heavily upon local elevators for transportation, storage, and drying. When the crop is harvested, farmers will either deliver soybeans to an elevator or the elevator will arrange for farmers or commercial truckers to deliver soybeans directly to the plant or port in the name of the local elevator. Due to the use of three different gauges of rail, the ability of the rail system to move agricultural goods is somewhat limited. Consequently, most grain is moved internally by truck. The gradual privatization of the port system in Argentina since the Junta Nacional de Granos was dissolved in 1991 has led to some reduction in inefficiencies and shipping costs, although progress has not been uniform in all areas (Kessler, 1993).

The grain marketing system in China is quite different from the type seen among Western Hemisphere soybean exporters. China has adequate on-farm storage because individual farms are so small that farmers can typically store their harvest in burlap sacks or wicker baskets. The wicker structures allow good air circulation, so some drying occurs naturally during storage. They also have some modern grain storage facilities. Beans are typically crushed within or near the production region or moved to ports for export. As rail and road facilities improve, China's soybean exports may decline since inter-provincial transport between surplus and deficit regions becomes more feasible. A majority of export soybeans are delivered to the ports by rail. Because exporting of soybeans is conducted on such a small scale (soybean exports account for about 11 percent of total disappearance), such soybeans are often shipped in bags rather than in bulk, because of the shortage of bulk handling equipment.

Effects of Government Policies on Soybean Quality

Explicit support for production of oilseeds and products is limited, with the most massive intervention occurring in the EC. No country directly supports exports of raw oilseeds, though some credit assistance is available. Although the incidence of government intervention in the soybean market is lower than for other commodity markets, the policies that do exist tend to concentrate on soybean yield, usually to the detriment of enhancing quality characteristics.

Government policies in key soybean-exporting countries provide direct and indirect incentives to produce soybeans. Soybeans are supported on a minor basis through the use of minimum price supports (in the United States) or credit subsidies to small-scale producers (in Brazil). Brazilian domestic policies in the 1970's, and indirectly U.S. domestic commodity policies in the 1980's, led to substantial increases in soybean area planted in Brazil and Argentina.[5] Brazil's soybean area reached a record in 1988. Argentina's soybean area continues to increase slowly. Since 1986, world soybean area planted has increased modestly; most of that increase has taken place in these two countries. The programs influence the mix of crops selected for cultivation by farmers, but none directly address cultivation and handling practices that affect the end-use performance of the commodity.

[5]High target prices and loan rates for program crops in the early 1980's, especially corn, made grain cultivation much more attractive to U.S. farmers than soybean cultivation in that period. This opened market opportunities for Brazil and Argentina.

U.S. commodity programs, although focused primarily on grains rather than oilseeds, are believed to have had a major, though indirect, effect on U.S. soybean cultivation in the last decade. This impact stems from the greater returns generated by U.S. programs for planting grains (especially corn) relative to those provided by the market for soybeans, together with disincentives for switching out of grain area planted under the commodity programs (even when soybean prices are favorable). For example, in 1990, net returns for soybeans exceeded corn market returns by 25 percent in the North Central region, but fell below corn program returns by about 10 percent (USDA/ERS, Feb. 1994). The addition of flexibility provisions in the 1990 FACTA, which allow farmers the option to plant grain and oilseeds based on relative profitability at market prices for between 15 and 25 percent of their base acreage, has led to a recovery in soybean planted area in the last few years. A small decline in 1993/94 harvested area occurred due to Midwest flooding. A soybean loan rate has been in effect since 1953 (except for 1975), but average market price has fallen below the loan rate only five times. The program plays a small role for farmers, except for cash flow (Crowder and Davison).

Some minor policies that regulate plant breeding practices do directly affect soybean quality. Such policies vary considerably among major soybean exporters. For example, in 1992, the Argentine Government imposed a law forbidding farmers who grow seeds under contract from marketing second-generation seeds (with less predictable characteristics) under the same commercial name. An Argentine government committee controls the licensing of new plant varieties (U.S. Congress). For new strains of soybeans, the committee focuses on potential improvements in the genetics of maturity date, disease resistance, and yield. A similar mechanism controls breeding in Brazil. Brazilian testing is divided into two separate stages because of differing demands on the genetics of the seed (agronomic versus end-use). Each new variety in Brazil goes through a series of tests and is not approved for distribution unless its superiority to existing strains is established scientifically.

A large number of private plant breeding firms have emerged in the United States since 1970, when the Plant Variety Protection Act took effect. These private firms and State agricultural experiment stations have accounted for most cultivars released since that time. The breeders' focus has been on advancing yields while maintaining minimum levels of oil and protein. These factors, as well as plant hardiness in the face of inclement weather, are the parameters of variety performance that are valued in the market. China allocates only modest resources to improve plant breeding, except for acreage contracted out by Japanese processors. These fields are planted with varieties designated and shipped by the contracting firms. The breeding for these food soybean varieties occurs in Japan.

The four major producers of soybeans all have varying policies for grading soybeans (table 6). For example, Argentina has only a base quality standard, with limits for moisture, brokens and splits, heat-damaged and total damaged kernels, and foreign material. The United States has four different numerical grades based on limits for six different physical quality factors: split beans, foreign material, total damaged and heat-damaged kernels, soybeans of other colors, and test weight. Brazil differentiates its two grades for export based on moisture content and foreign material.[6] The tighter FM limits on the highest Brazilian grade soybean enhances Brazil's image as a high-quality exporter. China has five numerical grades which are differentiated by only one factor, a minimum purity index, based on the percentage of pure, nondefective kernels (Bender, Hill, and Valdes).

Importers and Import Decisionmaking

The world's exporters of oilseeds and products offer products with different characteristics from which importers must choose. Buyers base their purchases on an array of factors, including the price and quality of the oilseed, supplier reliability, and quick access to the commodity. This study reveals that quality, among the various factors considered by importers, is usually second to price in determining the source of their oilseed or protein meal purchases, although these two aspects are closely tied via the crush margin. An importing country's capacity to crush oilseeds profitably and related input and processing subsidies largely dictate the choice between oilseeds and meal imports for feed purposes. This section looks at the aggregate relationship between quality and price prevailing on the world market, and then examines the feed and food submarkets in more detail.

Quality Comparisons and Prevailing Price Relationships

The price of imported soybeans or soybean meal, instead of quality, was regarded by the majority of buyers in the study countries as the most important criterion, though these two factors are inextricably linked. This linkage stems from the desire on the part of importers and crushers to maintain a profitable crushing margin, in which quality plays a role. In general, buyers treat price and quality as a tradeoff and are often willing to accept

[6]Brazilian exports are typically Grade No. 1, which permits no more than 1 percent of FM.

Table 6--Grade determining factors for soybeans in selected exporting countries

Specifications	Brazil	China	Argentina	United States
Number of grades	2	5	1	4
Splits or broken			x	x
Foreign material	x		x	x
Total damaged kernels			x	x
Heat-damaged kernels			x	x
Test weight				x
Moisture content	x		x	
Soybeans of other colors				x
Minimum purity index		x		
Standard of quality				

Sources: Bender, Hill, and Valdes; U.S. Congress.

slightly lower quality for a lower price. In world commodity markets, an importer's attitude toward the tradeoff between price and quality may depend on the final use of the commodity. If the soybeans are destined for food processing or full fat processing for feed (as sometimes occurs in Western Europe), the purchaser may emphasize certain quality attributes. Examples of this are low FM and split beans, a very low limit of seed damage, and requiring soybeans be grown from certain white hilum varieties. If the soybeans are intended for feed manufacturing, however, the importer is more likely to compare the value of protein and oil of a given soybean shipment with other oilseeds. A crusher's ability to shift between oilseeds is often limited by the costs of re-tooling crushing facilities. Oilseed meals may also be chosen.

Quality Comparisons

While the United States dominates the world soybean market in volume terms, Brazilian beans are regarded in most major importing countries as being of better quality than U.S. beans (table 7). This quality preference stems from the perception of Brazilian beans being consistently higher in both protein and oil content than U.S. soybeans, and consistently lower in foreign material content. Brazilian beans sold to Japan averaged 1-percent lower FM content and 1-percent higher oil content between 1987-91. Brazilian traders frequently offer contractual guarantees to importers on these grounds. Brazilian soybeans are, however, sometimes avoided because of the red color of the beans, drawn from the soil in which they are grown. This coating discolors the products during processing. Japanese processors use an activated clay to bleach the reddish tint out of oil from Brazilian beans, raising processing costs. Some importers lump South American beans together and declare them superior in quality to U.S. beans, but most differentiate South American beans by country of origin.

Bolivia, though only a minor player in the world market, is regarded by Venezuelan crushers as exporting high-quality soybeans, preferred even to Brazilian beans. Argentine beans are viewed in some markets as lower in quality than Brazilian or U.S. soybeans, due to lower protein content and oil content and quality, although other factors such as the smallness of the beans, lack of uniformity, and the same red coloring which plagues Brazilian beans are also cited.[7] Data suggest that Argentine soybeans have a higher percentage of splits but generally lower foreign material than U.S. soybeans (table 8). Soybeans from no other origins were mentioned by importers of beans for feed processing in terms of their quality ranking relative to U.S. soybeans. A few importers mentioned preferring to buy soybean meal from Argentina or Brazil rather than the United States because it typically arrives in pelletized form. U.S. soymeal shipped in bulk can create handling problems at import facilities, particularly if it sits in holds for extended periods and begins to cake.

Some Asian markets also use substantial amounts of soybeans for food purposes. The main exporters to these markets are China and the United States. Food beans are often purchased by government agencies, which may constrain processors' ability to indicate their preferences between sources. Processors' source preferences depend largely on the final product. Chinese beans are preferred for certain food uses because they are larger sized, higher in carbohydrate and moisture content, and viewed as 'fresher,' although they are generally lower in protein

[7]EC crushers generally view Argentine soybeans as superior to U.S. soybeans.

Table 7--Summary of country interview results

Country	Market shares[1]		Total use breakdown	Sourcing factors[2]	Quality factors[2]
Indonesia	Food: China 91% U.S. 8%	Feed: U.S. 44% China 44% Argentina 12% (1991)	Crush--40% Food--60%	Food use: Reliability of supply Price Quality Feed use: Timing of shipment Price Quality	Food use: Protein Moisture Test weight Feed use: Oil
Japan	U.S. 56% China 28% Other 16% (1990)	U.S. 78% Brazil 22%	Crush--81% Food--19%	Price Quality Seasonal availability	Oil content Protein content Color Size Foreign material
Italy	Beans: Argentina 33% Brazil 24% U.S. 20% (1989/90)	Meal: Brazil 68% Argentina 17% U.S. 11%	Crush--99% Food--1%	Price Protein Season	Protein consistency Moisture content Cleanliness
Mexico	U.S. 100% (199/91-91/92 average)	U.S. 100%	Crush--100%	Price Credit availability Quality Timely shipments	Protein Oil Moisture
The Netherlands	U.S. 53% Brazil 26% Argentina 17%		Crush--91% Feed--9%	Price Cleanliness Intrinsic quality Trade servicing	Oil content Foreign material Moisture Protein content
Poland	EC 100%[3]		Crush--100%	Price Intrinsic quality Contract execution Government regulations Credit availability	Protein content Fiber Oil content Protein consistency Free fatty acids
Russia	U.S. 90% Argentina 5%	U.S. 60% Argentina 8% EC 7% Brazil 6%	Crush--97% Food--3%	Credit availability Price	Splits Foreign material Oil content Quarantine seeds

Footnotes at end of table.

Continued--

Table 7--Summary of country interview results--Continued

Country	Market shares[1]		Total use breakdown	Sourcing factors[2]	Quality factors[2]
	Beans:	Meal:			
South Korea	U.S. 90%	China 36%	Crush--67%	Price	Protein content
	Brazil 3%	Brazil 20%	Food--33%	Quality	Oil content
		India 11%			Foreign material
		Others 32%			
Spain	U.S. 61%	Brazil 58%	Crush--86%	Price	Protein/
	Brazil 26%	Argentina 35%	Feed--14%	Quality	Oil content
	Argentina 9%	U.S. 3%		Trade servicing/	Foreign material/
				Company relationships	Moisture
Taiwan	U.S. 97%		Crush--84%	Price	Protein content
	Argentina 3%		Food--12%	Quality	Oil content
			Direct feed--4%	Supply reliability	Foreign material
					Splits
Venezuela	U.S. 100%	U.S. 87%	Crush-99%	Credit	Moisture
		Brazil 9%	Food-1%	Price	Protein content
				Quality	Foreign material
					Free fatty acids
					Oil content

[1]Market share figures are from 1992, unless specified otherwise in table. [2]Sourcing and quality factors are listed in order of overall importance.
[3]Market share from Mar. 1993. Prior to association agreement with EC, Poland imported soybean meal from Brazil and Argentina.

Table 8--Aggregate quality comparisons among selected major soybean exporters, 1984-91

Item	1984	1985	1986	1987	1988	1989	1990	1991
				Percent				
Argentina:								
Moisture	11.7	11.7	11.8	11.8	11.5	11.9	---	---
Splits[1]	12.1	9.1	12.3	11.4	9.9	8.5	---	---
FM	0.5	0.4	0.5	0.5	0.4	0.4	---	---
Brazil:[2]								
Moisture	---	12.2	12.3	11.9	11.6	12.3	11.3	12.1
Splits	---	12.2	10.9	9.9	12.6	12.3	11.1	11.3
FM	---	1.2	1.3	1.1	1.4	1.2	1.2	1.2
Damaged kernels	---	2.8	4.1	4.5	2.9	2.6	3.3	2.9
Oil	---	---	---	---	---	19.7	20.0	20.1
Protein	---	---	---	---	---	35.8	36.1	36.0
United States:								
Moisture	12.6	13.0	12.9	12.6	11.6	12.1	11.7	12.1
Splits	7.3	5.9	9.4	9.3	11.1	9.0	9.9	7.8
FM	1.8	1.9	1.9	1.7	1.9	1.9	1.8	1.7
Damaged kernels[3]	1.1	2.4	2.2	2.0	1.8	0.9	0.9	0.9
Oil	---	---	---	---	---	18.4	18.6	19.0
Protein	---	---	---	---	---	35.5	35.5	35.2

--- = data not available. [1]Argentine limits on splits in soybean exports are 30 percent higher than limits for U.S. No. 2. [2]Brazilian data for exports to Japan only, measured at delivery. [3]Damaged kernels measured for U.S. exports at delivery to Japan only. Sources: Bender, Hill, and Valdes, Appendix C, 1992; Japanese Oil Processors Association; USDA/FGIS, *1992 U.S. Grain Export: Quality Report*, 1993.

content than U.S. beans. The higher carbohydrate content makes Chinese beans more suited to certain food products than for crushing.

Prevailing Price Relationships

In part because of disincentives for storage, Brazilian and Argentine soybeans and soybean product exports are often priced below those sold from the United States during their prime marketing season. Importers evaluate relative prices between suppliers of beans within a context of bean yields of protein and oil. Since Brazilian beans generally contain higher proportions of oil and protein than do U.S. beans, the buyer benefits not only from the lower Brazilian price but also from the soybeans' greater productivity.

U.S. beans are price competitive for the most part in Western Hemisphere markets, such as Mexico and Venezuela. This competitiveness stems mostly from lower shipping costs, considerably lower from U.S. Gulf ports than from the major Argentine and Brazilian ports. Similarly, lower transport costs give China a price advantage in Asian markets such as Indonesia and Korea (table 9). The small size of Chinese ships and the bagging of export beans also gives them an unloading cost edge in markets with older unloading technology and small-scale crushers. Brazilian beans shipped from certain ports, which are perceived as being the best-quality soybeans available on the world market, are often sold at a discount to U.S. soybeans. This phenomenon is a result of little incentive for Brazilian producers to bear the storage costs for beans in a climate of inflation. Relative prices between U.S. and competitors' soybeans depend almost entirely on which point in the marketing year one is observing, particularly with respect to comparisons between U.S. and South American beans. Brazilian and Argentine beans are typically competitive with (or priced just below) U.S. beans during their prime marketing period, and mostly unavailable during the rest of the year. Many importers switch between sources on the basis of the seasonal shifts. The inadequacy of the Brazilian storage and transportation system denies Brazilian producers the advantage that their higher quality product would otherwise reap on the world market.

There is less of a seasonal component in the price relationship between U.S. and Chinese soybeans, which is governed by demand in the food soybean submarket. Prices for food soybeans are competitive between the United States and China, and are $25-$35/ton higher than for soybeans destined for crushing.

Table 9--Summary of key price and quality results

Country	Soybean sample price relationships				Average FM		Anticipated change in imports of U.S. soybeans due to lower FM	Expected premium from low-FM beans
	Year/basis	*----Dollars per ton-----*						
		U.S.	Argentina	Brazil				
Indonesia	1990/91/c&f (feed)	255	253	253	U.S.	1.4[1]	No change	No change in feed market
		U.S.	China		Argentina	2.0[1,2]		For food, 4-percent premium
	1990/91/c&f (food)	285[3]	279		Brazil	2.0[1,2]		for 1-percent reduction in FM
					China	0.6[1]		
		U.S.	Argentina					
Italy	Mar. 1990/f.o.b.	225.40			No data		No change	None anticipated
Japan		U.S.	Brazil	China	U.S.	2.1[4]	Would help stem loss	Possible $0.035/bu premium
	1990/91/c&f	269.12	261.11	294.445[5]	Brazil	1.3[4]	of U.S. market share	for 1-percent FM beans
Mexico	Jan. 1992/f.o.b.	233.40			U.S.	2.9[4]	No change	None anticipated
	Mar. 1992/f.o.b.	226.96						
The Netherlands	1992/c.i.f.	235.50			U.S.	1.8[1]	Little or no change	None anticipated
Poland	1991/c.i.f.[6]	278.00			No measure		Minimal trade exists	None anticipated
Russia		U.S.			U.S.	<2[1]	No change	None anticipated
	1990/91/f.o.b.	224.00						
	1992/93/fo.b.	224.00						
South Korea	1991/c.i.f.	266.00		218.00	U.S.	2.3[4]	No change	None anticipated
	1992/c.i.f.	256.00	250.00		Brazil (1990)	0.9[4]		
Spain	1990/91/f.o.b.	225.65			U.S.	2-3[4]	Little or no change	None anticipated
	1991/92/f.o.b.	215.06						
Taiwan	1992/c&f	241.00	230.00		U.S.	2.4[4]	Retain market share	None anticipated
					Argentina	0.7[4]		
Venezuela	1991/c&f	245.00			U.S.	2.0[4]	No change	Single respondent--1-percent premium

c&f= cost and freight; c.i.f.= cost, insurance, and freight; f.o.b.=free on board. [1]Measured at export (USDA/FGIS). [2]U.S. soybeans sold to Indonesia for feed use are U.S. No. 2, while beans for food use are U.S. No. 1. [3]Represents grade No. 2 soybeans for Brazil and Argentina. [4]Estimated level of FM at delivery. [5]Chinese soybean exports to Japan are for food use only. [6]The small amount of soybeans imported into Poland are repurchased in odd lots at Rotterdam, and are likely to be of U.S. origin.

Importer Case Study Procedures

A series of 11 country case studies was conducted for major importers of U.S. soybeans and soymeal between April and September of 1992 (table 10). An examination of the market structures and buying practices of these countries reveals how the world soybean market might respond to changing price and quality conditions. These 10 countries (excluding Poland, which currently imports no U.S. soybeans or soymeal) are among the largest importers of U.S. soybeans and soymeal (accounting for 75 and 54 percent of total U.S. exports respectively between 1987 and 1991). Soybean imports by these countries totaled 19.4 million tons in 1992, accounting for about two-thirds of world soybean trade. Seven of these countries now import more soybeans or soybean products from all sources than they did in the mid-1980's, but only four of them (Japan, Mexico, South Korea, and Taiwan) import more from the United States. The EC countries in this study (Italy, the Netherlands, and Spain) have expanded total imports (soybean equivalent) but their U.S. imports have declined.

A series of interviews conducted on-site by teams of ERS analysts provided the basis of the country studies. Interview guidelines were created with the help of experts in the U.S. oilseeds trade, and tailored to each importing country with advice from U.S. Embassy and trade association officials. The interviews were designed to gain understanding of the respondents' roles in import sourcing, identify the key factors entering that decisionmaking process, and to explore the importers' views of the relative quality performance of U.S. soybeans with respect to both the relevant set of quality factors and competitors' performances. The importance of FM was examined within the potential set of factors which could be used as decision criteria.

This section of the report consists of three major parts: (1) identification of the major users of soybeans and soybean products, such as soybean crushers, livestock producers, feed compounders, soybean food processors, and traders, and their influence over quality specifications in export contracts, (2) the composition of domestic consumption (including the choice between beans and meal) and policies that affect import volume determination, and (3) the factors, including price, credit, trade-servicing relationships, and quality, that influence import sourcing.

While users of oilseeds and products differ in some ways, the process of determining import volume seems quite universal. The major players involved (identified in part one) estimate import needs by forecasting domestic soybean and oilseed production (if any occurs) and consumption needs.[8] In the case of the Netherlands, considerable re-exporting of soybean meal after crushing of imported beans occurs. These levels may be affected by government intervention, so relevant policies are also examined in part two. Import needs are derived from general demands of end-users, within financial and political constraints and import priorities. In the third part, import needs are filled by selecting between importing beans and meal, and the type and source of oilseeds and meals to import.

The import decisionmaking framework incorporates elements such as price offered (and related factors such as export credit and transportation costs), price of competing products, quality, trade-servicing/supply reliability, and presence of trade agreements or political relationships with some exporters. For the purposes of this report, the market will be divided into feed and food submarkets.

The World Feed Market for Soybeans and Soymeal

The majority of imported soybeans or soybean meal is consumed in the livestock sector. Soybean oil is produced jointly with soybean meal and is typically destined for human consumption (a minor amount is used in industrial processes). Crush as a share of total use exceeds 80 percent in most regions in the world, except in areas where food use (mostly East Asia) accounts for a large share of demand. Within the countries examined in this study, 7 of the 11 countries crush at least 80 percent of their soybeans (domestic and imported) for use in livestock feeding (see appendix A for details on the crushing process). In addition, an average of 1.7 million tons of soybeans imported by the EC are fed to livestock as full-fat soybeans rather than soymeal. This section discusses how oilseed demand is determined and how the import mix of oilseeds and products is determined.

Major Players in Import Decisions

In a given country's oilseed sector, there are four major sets of players: oilseed and livestock producers, feed manufacturers, oilseed crushers, and grain traders. In a few instances, government agencies play a role. Livestock and poultry producers generate the basic demand for oilseeds and protein meals. In countries where arable land is abundant, many livestock farmers also raise crops, including oilseeds. However, only a very few large-scale producers have their own soybean crushing facilities or extruders, so they must either purchase oilseed meal and mix their own feeds or purchase complete feeds from compounders. If the crushers and feed manufacturers

[8]In market economies, the decision on how much to import in a given year is made individually by traders and soybean end-users, but can be aggregated over all firms to yield a figure for total import demand for that country.

Table 10--Summary of national soybean sectors in study

Country	Respondents interviewed	Interviews represent percent of import market	Per capita consumption[1,2]	Domestic production[1]	Trade/domestic policies	Total imports[1]
	Respondents	*Percent*	*Kilograms*	*Million tons*	*Policies*	*Million tons*
Indonesia	1 state trader 1 crusher 2 feed mills 1 cooperative 1 soybean distributor	100	crush--2.4 food--9.0	1.54	State control on bean imports; tariff and surcharge on meal prior to June 1993; now meal content restricted Administered prices for dom. meal	beans--0.53 meal--0.19 oil--0.00
Italy	3 traders	95	crush--55 kg food--minimal	1.15	Zero duty; per-hectare payment to producers	beans--1.34 meal--1.5 oil--0.012
Japan	5 trading companies 1 large cooperative 6 crushers	62 (beans traded) 52 (beans crushed)	crush--29 kg food--7.5 kg	0.20	Zero duty on soybeans; small duty on soybean oil; zero duty on soybean meal	beans--4.5 meal--0.8 oil--0.0 (1991)
Mexico	10 traders	85	crush--29 kg	0.40	Ad valorem tariffs on oil and meal; Seasonal tariff on beans; Producer support payments	beans--2.2 meal--0.4 oil--0.075
The Netherlands	3 crushers 1 feed manufacturer	95	crush--237 kg feed--30 kg[5]	0	Same as Italy	beans--4.37 meal--1.38 oil--0.03
Poland	2 feed mills 2 traders 1 state trader	100	crush--19 kg	0	10-percent tariff on all soybean meals except EC soybean meal (no tariff); Uniform 5-percent tariff on soybeans, 10-percent on soybean oil	beans--0.50 meal--0.60 (1991/92)

Continued--

Footnotes at end of table.

Table 10--Summary of national soybean sectors in study--Continued

Country	Respondents interviewed	Interviews represent percent of import market	Per capita consumption[1,2]	Domestic production[1]	Trade/domestic policies	Total imports[1]
	Respondents	*Percent*	*Kilograms*	*Million tons*	*Policies*	*Million tons*
Russia	1 state trader 1 state distributor	100	crush--9.6 food--0.3[4]	0.51[3]	State control	beans--0.14[3] meal--1.0 oil--0.2
South Korea	3 crushers 1 feed association 1 livestock cooperative 1 processors association 1 government official	95	crush--20 kg food--8 kg	0.17	Tariffs on oil (25%), beans (3%) nonbinding import quota for beans domestic price supports	beans--1.1 meal--0.72 oil--0.011
Spain	3 integrated grain firms, multi-national 1 multinational trading company 1 feed manufacturer	90	crush--78 kg feed--13 kg[5]	0.033	Same as Italy	beans--2.56 meal--1.5 oil--0.00[6]
Taiwan	1 trade association 7 crushers	50	crush--80 kg food--11 kg feed--4 kg[5]	0.008	Guaranteed domestic price; peanut and peanut product imports banned	beans--1.96 meal--0.20 oil--0.005 (1991)
Venezuela	3 processors 3 traders 2 feed associations	crushing-67% feed mfg.-46%	crush-44 kg food--1 kg	0.005	Differential tariff system-- preference to Andean Pact members; Price bands for beans, meal, oil; Regional bilateral agreements	beans--0.16 meal--0.55 oil--0.13

[1]Production, consumption, and import figures are from 1992, unless specified otherwise. [2]Represents amount of beans crushed or meal fed to livestock versus soybeans used solely for food processing. About 80 percent of figure goes for soybean meal use, and about 20 percent for soybean oil use. [3]Statistics for Russian Federation only. Others report FSU-12 figures. [4]Food consumption figures for Russia also include seed use and waste. [5]Accounts for full fat beans roasted or extruded whole and fed to hogs or poultry. [6]Spain is a net soybean oil exporter.

Table 11--Soybean and protein meal self-sufficiency ratios, 1992

Country	Soybean self-sufficiency[1]	Protein self-sufficiency[1,2,3]	Soymeal import share
		Percent	
Indonesia	68.5	65.5	17.3
Italy	25.3	25.8	55.7
Japan	3.0	2.3	21.0
Mexico	17.3	16.8	16.8
The Netherlands	0.0	0.1	28.2
Poland	0.0	30.0	91.5
Russia[4]	22.7	58.6	91.0
South Korea	8.0	6.1	45.5
Spain	0.0	12.4	42.5
Taiwan	0.3	1.2	10.8
Venezuela	3.0	4.1	83.2

[1]Reflects self-sufficiency of total demand in soymeal equivalent (domestic crush+other domestic uses/domestic production). [2]Includes fish meal consumption where relevant and palm kernel production and use in Indonesia. [3]Calculated in 44-percent soybean meal equivalents. [4]Data are for FSU. Source: USDA/ERS, Aug. 1994.

cannot obtain enough oilseeds from domestic sources, they must import the oilseeds (table 11). Most feed processors import oilseeds or protein meals through traders or independent crushing firms in their own countries.

Some highly integrated, large-scale firms crush soybeans and other oilseeds and conduct trade with their own subsidiaries in exporting countries. These multinational firms have become highly integrated in some countries, particularly those involved in poultry production. In countries where private traders dominate transactions (accounting for 9 of 11 countries studied), end-users participate in deciding types and quality of feed ingredients. Feed processors and grain traders, however, usually standardize import contract specifications in line with relative prices and general availability.

Livestock Sectors. Per capita use of meat and dairy products has grown since 1975 in most countries examined in this study (see appendix table 5). The exceptions have been Venezuela and Mexico, where per capita meat demand has fallen as relative prices have become market-determined rather than policy-determined. Milk use has also declined in Russia for similar reasons.

Dairy industries, which feed soybean meal, exist in most countries in the world because fluid milk is rarely traded across borders.[9] Exclusively grass-fed dairy operations do exist, but their milk output per head is typically only a fraction of the productivity of grain- and meal-fed dairy cattle. Little soymeal is fed to beef cattle in the countries examined in this study.

Pork is produced relatively widely among the study countries--only Japan is a significant pork importer, and Taiwan is a net exporter of pork. Most swine in the countries studied are raised in modern confinement operations, with considerable vertical integration between feed manufacturing, livestock feeding, and livestock processing activities. Large-scale, modern poultry facilities, operated by large firms and farmer-owned cooperatives, account for the majority of poultry production in Spain, Mexico, Venezuela, Taiwan, Japan, and South Korea.

Similar large-scale (though less modern) poultry operations are operated by the state in Russia, though small private operations also exist there (Bishop and others). The integrated poultry system, in which one firm controls all the separate stages (hatching eggs, raising the broilers, and processing and shipping the meat), is common for poultry operations in the study countries. The operators of these large-scale pork and poultry firms wield much influence in selecting feed ingredients that are imported, with the largest ones buying directly.

Requirements for protein in rations differ considerably between the livestock types discussed above. Rations for feeder calves, dairy cattle, and broilers are frequently 30-50 percent richer in protein meals than are swine and beef cattle rations. Large-scale confinement operations also

[9]Fluid milk is rarely traded because its water content and perishability make it uneconomical to ship. Dairy products are normally traded as milk powder or processed products such as cheese.

appear more likely to feed compound rations than smaller operations. The sanitary condition of the original feed ingredients is often important, because certain harmful substances can be concentrated within animals' internal organs and muscle tissue which cannot be removed during meat processing.

Oilseed Processors. Most of the countries studied currently favor importing soybeans over soybean meal. That import preference is influenced by government policies as well as the status of the domestic crushing industry. In 1992, only 4 of the 11 countries in the study acquired more than 50 percent of their soybean product imports in the form of meals (see table 11). Of these, the crushing sectors in Russia, Poland, and Venezuela are characterized by obsolete and/or inefficient technology. On the other hand, Italy's dominant firm crushes many of its imported beans in facilities outside of Italy.

Oilseed crushing within most of these countries is conducted by a few dominant firms, primarily because of the economies of scale involved in the operations. Most of these firms also handle their import transactions as well, or, as in the case of Japan, within a processors' association. With the liberalization of soybean trade in Taiwan in 1988, their highly regulated trade system for soybeans was handed over to seven different groups, including the Taiwan Sugar Corporation, which among other activities operates a vertically integrated hog production facility. The state is heavily involved in crushing in only two study countries, Indonesia and Russia. In both countries, state agencies acquire and allocate the beans to the crushers, which in the case of Indonesia is a heavily subsidized single facility. The crushing facility in Indonesia does not take title to the beans, but only crushes them for a state-determined fee. In all of the countries studied, the crushing firms operate independently of the feed processing firms. Crushing firms in Japan also refine and market vegetable oil for human consumption, although most crushing sectors are not integrated to that extent.

Feed Processors. Specialized dairy operations and the production of swine and poultry in confinement operations all require efficient mixing of feeds. This requirement has led to the development of a compound feed industry in most countries in this study. Compound feed processors acquire feed ingredients from various sources (domestic and foreign), and mix them in specific rations. Significant economies of scale are usually present in the manufacture of formula feed, some stemming from barriers to entry created by government policies discussed below. These economies of scale appear to have been captured to a large extent in the countries examined in this report, given the large market share these few firms appear to hold in the oilseed sectors.

In these countries, the economies of scale in feed manufacture are captured either by large private firms or by farmer-owned agricultural cooperatives or associations. Large-scale feed processors and agricultural cooperatives have often diversified their operations, also becoming involved in ownership of large commercial poultry and hog operations. Large-scale private feed processors often buy directly from their own subsidiaries in exporting countries, while smaller firms deal through traders (who generally handle both bulk soybeans and soybean meal).

Full-fat soybeans are processed in separate facilities, due to different equipment needs. In the EC, soybeans used for this purpose amount to more than 1.7 million tons annually. Soybeans prepared in this manner are used mostly in hog and poultry feed rations. Many of these plants are owned by the same multinational grain corporations which operate most EC crushing facilities.

Traders. State traders in the world soybean and soymeal market play a major role in only a few countries. Governments in developing countries traditionally devote considerably more resources to ensuring stable supplies of basic food staples. This attention toward obtaining soybeans appears primarily in the few countries where soybean products like tofu are a food staple (such as Indonesia and South Korea). In contrast, meat and poultry consumption is not a concern of most governments, thus transactions for livestock feed are made privately.

Among the countries examined in this study, the Russian and Mexican feed sectors are the most heavily influenced by their governments. The Russian state trading organization, Exportkhleb, handles all agricultural imports, including oilseeds and oilseed meals. The commodities acquired by Exportkhleb are then allocated to the various crushing enterprises by Pishchepromseryo, the oilseed distribution committee. In Mexico, the state agricultural marketing agency, *CONASUPO*, was the major importer before 1985 reforms, but now grants import licenses fairly freely to private traders.

In other study countries, most soybean or soymeal imports are handled either by large firms, often affiliated with multinational grain trading firms, or trading associations or cooperatives. The exceptions are the large integrated multinational and national firms, who conduct their own trading operations. Import decisions in most of these countries are influenced by government policies, but actual deals are conducted by companies (local and national) interested in maximizing profits and keeping their customers (feed processors and livestock producers) satisfied with their products.

Key Factors Affecting Import Decisions

Government intervention plays a modest role in determining the volume of soybean or soymeal imports. Domestic production of soybeans or other oilseeds makes a substantial contribution to total oilseed or meal supply in 5 of the 11 countries examined (Indonesia, Poland, Spain, Italy, and Russia). Domestic producers in most of these countries are supported in their efforts (see table 10). The EC provides generous per-hectare payments to its oilseed producers, while Mexico also distributes smaller support payments. South Korea, Taiwan, and Venezuela all provide price support to producers. Tariffs are applied more consistently to soybean products than to raw beans, though tariff levels on those products are not prohibitive in most cases. The tariff structure in Poland and Venezuela tends to favor meal over beans in import decisions, and in Japan and Korea they favor importing raw beans over soyoil.

Domestic Production. Of the countries included in this report, only Indonesia produces more than half of the soybeans needed for its domestic use (see table 11). Indonesian soybeans are more suited for food than for crushing purposes. Italy and Mexico produce some soybeans, but both account for less than a quarter of domestic needs. Russian, Polish, and Spanish farmers produce other oilseeds, which fill a portion of domestic meal demand. Russian oilseed production (mainly sunflowerseed and rapeseed) is relatively small, but accounts for a large share of total demand because livestock feed rations are heavily grain-oriented. Polish farmers in some years produce more rapeseed than their crushing facilities can handle, although recent exports have occurred more as a result of uncertain domestic distribution channels and higher world prices than actual excess production (Cochrane and others, 1993). Spanish sunflowerseed production has averaged more than a million tons over the last 5 years, primarily as a result of producer support under the EC's Common Agricultural Policy (CAP). The other countries examined grow minor amounts of oilseeds, meeting less than 6 percent of demand.

Domestic Consumption. Feed use of protein meal is a derived demand, depending upon a given population's demand for meat and poultry products. For countries with an inadequate crop base to support domestic demand for meat and livestock products, the initial choice is whether to import feed or import meat. Many countries prefer to import the bulk feed ingredients (grain and oilseeds) and raise the livestock themselves. By doing this, countries are able to retain the value-added portion of retail price of meat in the domestic economy, and also tailor the final product more astutely to local consumer tastes. The cost of shipping a more perishable commodity (meat or poultry) long distances also affects the decision.

Since meat is often regarded as a luxury good with respect to a market basket of food items, the absolute levels of meat consumption and feed demand are typically correlated with higher per capita income. Empirical analysis shows that per capita incomes of customers for U.S. soybeans are 50 to 70 percent higher than incomes of customers of U.S. wheat on average (Childs and Mercier). Consumer choices between meat types are determined primarily by relative prices, cultural preferences, and dietary concerns, the last factor of more concern in developed countries.

Because meat and poultry are not seen as staple goods, their production and use do not receive direct government support as frequently as such support is offered for grains and oilseeds. A major exception to this is the EC. *Phytosanitary and sanitary regulations* exist in most countries; some can be justified on a scientific basis (such as restrictions on beef exports from regions having hoof-and-mouth disease problems). However, often these rules are used as thinly concealed trade barriers (Office of U.S. Trade Representative). Producers in several of the countries studied are protected by barriers (such as variable levies, import or tariff quotas) which impede the importation of meat (see appendix table 6). The frequency of trade barriers affecting meat and livestock imports relative to those affecting oilseed or meal imports suggests that government policy generally promotes importing feed rather than meat. Countries that commonly engage in transhipping meal (such as the Netherlands) are less concerned about domestic use, and more about demand in nearby markets.

Key Factors in Determining Import Source

The process of choosing an oilseed or meal for import implicitly contains an intermediate step within the decisionmaking process. Once the supply of domestic feed determines the import levels needed to fill consumption requirements, crushers and feed manufacturers (either separately or together) decide which oilseed when crushed would maximize their returns and meet livestocks' nutritional requirements. In most countries, the decision on which oilseeds to acquire is made based on the technical efficiencies of the crushing facilities and the relative prices of meal and oil. A change in relative prices between meal and oil can cause a shift in imports between high protein oilseeds (such as soybeans) and high oil oilseeds (such as low-erucic-acid rapeseed, also known as canola). Such a shift occurred in Japan in 1992/93 because of the high price of canola.

Price is viewed as the prime sourcing criterion for soybean importers for feed purposes in 8 of the 11 countries, with quality closely tied to price in many instances. Crushers in many countries (especially in Western Europe) pay such close attention to profit and crushing margin that they entirely close down operations when importing meal becomes more profitable.

Russian and Venezuelan soybean users, however, view credit availability as the prime constraint on soybean or soymeal imports, and Indonesian users view aspects of trade servicing (such as reliability of supply and timing of shipment) as the most important (see table 7). Credit (which lowers the net price of soybeans) also ranked among the top three factors in Mexico. Five of the countries studied (Russia, Venezuela, South Korea, Indonesia, and Mexico) have received U.S. export credit guarantees in recent years; however, these countries typically account for less than 20 percent of U.S. soybean exports. Reliance on credit for U.S. soybean imports ranges from near total dependence for Russia, which bought U.S. grain, oilseeds, and meal almost exclusively on credit in the early 1990's (except for food aid imports), to only 20-percent coverage for South Korean soybean imports. In Korea, credit plays a role in sourcing decisions and likely contributes to the price premium for U.S. beans over Argentine beans. In Venezuela, the availability of export credit for U.S. beans contrasts the lack of credit offered importers of Bolivian and Argentine soybeans and the occasional request to make advance payments for them.

The trade-servicing capability of an exporter, defined as the ability to provide cost-effective, reliable and timely deliveries, with effective customer follow-up, is also related to price and to an importer's sourcing choice. Aspects of trade servicing were listed as key decision criteria in 8 of the 11 countries. U.S. soybean exporters usually rate well in this category, because of the size and efficiency of the U.S. market.

The size of panamax vessels (holding at least 50,000 tons) that usually carry U.S. soybeans to foreign ports reduces per-unit costs, as does the ability of U.S. shippers to maintain a steady supply of commodity year-round. The proximity of U.S. Gulf ports to Mexican and Venezuelan ports gives U.S. traders a cost advantage over competitors for those two markets. Freight rates for U.S. soybeans are $15-$20 per ton lower to Mexico than rates for Argentine soybeans. U.S. goods are also moved by rail to Mexico, but over the last 5 years, rail costs have slightly exceeded shipping costs.

The importance placed by crushers and feed manufacturers on a steady and reliable supply as well as reduced shipping costs has in some cases led them to select U.S. soybeans or meal over imports from other origins, even when they regard U.S. products as lower in quality. The low storage capacity of some Dutch crushers causes them to prefer U.S. soybeans because U.S. traders can assure a steady flow of product. U.S. exporters also have a transportation cost advantage of $6-$10/ton over Brazilian traders into the Japanese market. In Venezuela, the lack of storage facilities and high cost of credit causes crushers to prefer U.S. soybeans over Argentine, because they are assured of reliable delivery within a week. Argentina sells at a discount in Taiwan because of slightly lower quality, but U.S. soybeans still dominate because of U.S. exporters' reliable shipping behavior. Crushers and feed processors in Taiwan, South Korea, and Venezuela regard Brazilian beans to be of superior quality to U.S. beans, yet U.S. exporters hold at least 90-percent shares of these markets, in part due to perceived Brazilian supply unreliability. The desire of authorities in Taiwan to maintain good political relations with the United States also contributes to the dominance of U.S. soybeans in that market. The size of the U.S. marketing system gives U.S. traders a price edge in many markets.

Despite its close relationship with price, quality was not listed as the prime criterion in the import decisionmaking process of crushers within the framework of the interview format. Quality ranks second to price in 6 of the 11 study countries: Italy, Japan, the Netherlands, South Korea, Spain, and Taiwan (see table 7). Quality was omitted as a decision criterion altogether in Russia. Among specific quality factors that are of concern, protein and oil content, moisture content, and foreign material are often rated as important. For importers of soybeans destined for crushing, concern over protein and oil content dominates all other quality considerations, because protein and oil content determine the profit the crushers will receive. The study countries are split between those viewing protein as the key characteristic and those regarding oil as the prime criterion, with the majority primarily concerned with protein. However, Japan and the Netherlands, the two largest single importers, listed oil content as the most important quality criterion. Both of these countries have oilseed processing sectors dominated by large firms whose integrated operations include refining and bottling soybean oil. Two countries, Russia and Venezuela, attach less importance to these characteristics. Interestingly, these are two of the three countries studied that import mostly soybean meal rather than beans for their protein needs.

Moisture content was mentioned specifically as a problem only by Mexican and Taiwanese traders, who found both U.S. and Argentine beans to contain excessive moisture. It was listed as an important quality factor in four other countries (Italy, the Netherlands, Spain, and Venezuela). High moisture raises handling costs (due to costs from additional drying), and can also lead to fermentation or spoilage on board ships. Most of the U.S. soybeans imported for crushing by these countries are purchased under standard contract specifications. The majority call for U.S. No. 2 soybeans, with few specifications tighter than existing grade factor limits.[10] Most also include a moisture maximum.

Attitude Toward Foreign Material

Foreign material ranks among the top four most important quality factors in eight of the countries studied, ranking as high as second in two countries (the Netherlands and Russia). It was also found that FM levels in U.S. soybeans are typically higher than levels found in Brazilian beans. Many importers buy No. 1 Brazilian beans, which contain half the level of U.S. No. 2 soybeans. However, only in Taiwan did respondents indicate that they specify FM limits which are tighter than grade standards on the U.S. soybeans they purchased.

The presence of FM in beans for crushing was problematic for several reasons. The key complaint was expressed along the lines of reluctance to "pay good money for material that does not yield meal and oil." High-FM soybeans not only worsen the problem of low crushing margins in some countries; they also pose a risk to bean crushers in meeting the minimum protein requirement for soymeal. Other issues include the cost of screenings disposal (particularly in Venezuela, where by law, screenings must be incinerated on the plant's premises), a higher share of *quarantine seeds* or insect damage with high-FM, and adverse effects on beans' storability and processing performance.

Individual crushers in two countries (Japan and Venezuela) importing U.S. soybeans for crushing appeared willing to pay a modest premium for soybeans with lower levels of FM (premiums of 3.5 cents a bushel cited in Japan, 6 cents/bu in Venezuela). No buyer indicated a willingness to expand imports of U.S. soybeans if soybeans with lower FM were offered at the same price, although some maintained that such a move would be helpful in maintaining U.S. market share at current levels (in Japan and Taiwan). This relative lack of interest stems from these facts: (1) those interested in low-FM soybeans for crushing can buy them from Brazil during part of the year without paying a higher price, (2) U.S. soybeans maintain the largest share of the soybean import market, due to U.S. production volume and its storage and shipping advantages, and (3) most crushers are familiar with the level of FM in U.S. soybeans and they have learned how to deal with it.

The World Soybean Market for Food Uses

Soybean processing for food products occurs to some extent in most of the countries featured in this study, accounting for an estimated 10-15 percent of total world soybean demand (see appendix A for details on food processing). Much of this demand is concentrated in Asian countries (see table 7). Quality requirements for food beans are different than those of soybeans crushed for feed purposes, because damaged, split, or moldy beans do not lead to a desirable final product. Food bean importers also prefer larger sized kernels and white hilum beans free of discoloration on seed coats. Such quality requirements also differ depending on the particular soybean food product. Domestic production of soybeans is largely destined for food use in these countries, but the majority of food soybeans are still imported in Taiwan and Japan. Imports of soybeans for food are handled by government agencies in South Korea and Indonesia, but move through private channels in Japan and Taiwan. Growth prospects for soybean import demand for food are not bright, with demand for soybean food products being displaced by meat as a movement toward more Westernized diets is evidenced in the higher income Asian countries. Growth in demand for soy food products varies across categories, but overall demand growth will not likely exceed population growth rates. The exception appears to be Indonesia, where per capita food use of soybeans has been growing steadily over the last 20 years.

Major Players in Import Decisions

The major importers in the food soybean submarket are the state traders in Indonesia (BULOG) and South Korea, and private traders and food companies in Japan and Taiwan. Beans grown domestically are marketed privately in Indonesia, and pass through long marketing chains before being acquired by the tofu or *tempe* cooperatives (called KOPTI's) or the Soybean Marketing Group. These groups, in turn, supply soybeans and soybean food products to both wholesale and retail markets. All prices are controlled by the government.

The Korean state trading agency (Agricultural and Fisheries Marketing Corporation, or AFMC) announces tenders for food soybeans (offers to buy) that do not specify origin while BULOG issues tenders for beans of U.S. and Chinese origin only. General consultation between processors and BULOG on quality issues does occur in Indonesia, though processors rarely can affect

[10]Most contracts for U.S. soybeans state the grade to be delivered as "U.S. No. 2 (or 3) or better." Such specifications shall be referred to as U.S. No. 2 (or 3) (see appendix table 7).

specifications for an individual tender. Processor cooperatives did succeed in convincing BULOG to purchase U.S. No. 1 soybeans rather than U.S. No. 2 in the mid-1980's, when China entered the market with good food-quality beans. Korean food processors have little input on the quality of food beans imported because AFMC buys on the basis of grade only.

Key Factors in Determining Import Volumes

As is the case with most types of food consumption, the level of demand for food soybeans is determined by a country's population and income. The need for imports is driven by the residual demand unsatisfied by domestic production. Indonesia and South Korea produce about 80 percent and 70 percent of the beans they use in their food sectors respectively, while both Japan and Taiwan must import more than 90 percent of their total food demand.

In both Indonesia and South Korea, the state agency imports the beans and resells them at controlled prices to food processors. Korean processor prices are 100 percent higher than the landed price. In Indonesia, the price differential between imported and domestic beans stems mostly from the difference in quality, but the processor price still exceeds landed price by about 40 percent. There is little intervention in the food soybean sectors in Japan and Taiwan.

Key Factors in Determining Import Source

The more rigorous quality requirements for soybeans used in the food processing submarket lead to a greater emphasis on quality in import decisionmaking for this use than exists in the feed submarket. Competition is more limited in the food submarket (primarily between U.S. and Chinese soybeans), and some importers of soybeans for food purposes have been paying premiums based on quality alone. Food users are concerned with a broader spectrum of quality characteristics than are feed users, although protein, foreign material, and moisture content rank as important in both submarkets.

Separate rankings of the importance of decision criteria were compiled for soybean food processors only for the Indonesia study, but for that country the array was quite similar between the food and the crush markets. Price is ranked as an important decision criterion for the most importers of soybeans for food purposes surveyed, although potential sources are limited due to tight quality requirements. Within Indonesia, Korea, Taiwan, and Japan, the major soybean sources are either domestic, United States, or China. South American beans in general are viewed as not having the desired characteristics for food processing (red-dust coating and damaged kernels causing special concern). Importers base their sourcing decision largely on their expectations of quality characteristics. Evaluating expected quality is particularly crucial if buying from a new source would require adjustment of the production process to accommodate differences in characteristics (such as bean size or carbohydrate content). Export programs (such as credit guarantees) which are offered to soybean importers for crushing are also available to food soybean importers. Such programs play a minor role in this submarket because most processing for food use occurs in high-income Asian countries, which usually do not receive export assistance.

In general, quality ranks behind price in this submarket in determining import source. Among specific quality factors, foreign material is ranked as important by soybean food processors. Foreign material contaminates the soymilk mixture, which is the first step in the production process, so processors try to clean out all FM before the beans enter soaking vats. Food processors incur additional cleaning costs (because of increased time) and have few outlets for selling the soybean screenings, unless they are located near feed mills.

Soybean food processors also consider bean size and shape, the percentage of split or damaged beans, protein content, moisture content, and lack of chemical residues to be important factors in their decisionmaking process. The significance of these criteria varies between final end-products. For example, in Japan, tofu manufacturers prefer large, light-colored beans, while *miso* manufacturers prefer beans with a high-sugar content. These specific quality concerns do not generally show up as additional contract specifications, although a few processors in South Korea and Japan have experimented with small shipments of *identity-preserved* U.S. soybeans.

Attitude Toward Foreign Material

Soybean food processors buy a higher percentage of U.S. No. 1 soybeans for their use than do soybean crushers, with corresponding lower FM content as prescribed in the grade limits. The share of U.S. No. 1 among total U.S. soybean exports is usually quite small, and likely goes primarily for food use (table 12). Of the more than 2 million tons of U.S. No. 1 soybeans sold to the countries examined in this study during 1985-93, more than 97 percent went to the four countries which use beans for food. In 1987, some Japanese soybean importers for crushing wrote contracts which specified a 1-percent FM maximum, but were dissatisfied with the results, and discontinued the effort. Japanese food processors buy U.S. No. 2 soybeans primarily from the Midwest (called *IOM beans*) because they get consistently higher protein levels from beans grown in that region. No respondents indicated they would anticipate a net benefit from

Table 12--U.S. total soybean exports to selected countries, by share of U.S. grade, 1986-92 average

Country	No. 1	No. 2 or better	No. 3 or better	No. 4 or worse	Un-graded[1]
			Percent		
Indonesia	56.1	43.9	0.0	0.0	0.0
Italy	0.0	39.8	58.0	3.0	0.0
Japan	1.4	94.6	3.1	0.1	0.8
Mexico	0.5	98.0	1.4	0.1	0.0
The Netherlands	0.1	89.5	8.4	1.1	0.8
Russia	0.0	98.6	0.0	0.0	1.4
South Korea	14.6	85.4	0.0	0.0	0.0
Spain	0.0	91.4	5.8	1.9	0.9
Taiwan	0.0	100.0	0.0	0.0	0.0
Venezuela	0.0	100.0	0.0	0.0	0.0
Average share	2.1	91.7	5.1	0.5	0.6

[1]Shipped through St. Lawrence Seaway to Atlantic Ocean via Canada, goes out ungraded by USDA/FGIS. Source: USDA/FGIS, 1986-92.

contracting for higher grade soybeans with lower FM than they already purchase. A few of them had already increased their share of U.S. No. 1 beans in the recent past. Their willingness to pay a premium above current price would depend primarily on prevailing price differentials between U.S. and Chinese soybeans. For 1990/91, buyers in Indonesia indicated a willingness to pay an $11/ton premium for cleaner U.S. soybeans for food use. There was some interest in expanding imports of U.S. soybeans with lower FM at the same price, notably in Japan. However, substantial improvements in U.S. market share or prices would be stimulated more readily by improvements in intrinsic factors such as protein content than by enhanced cleanliness alone.

Comparisons of U.S. Soybean Performance and Importers' Needs

All this examination of the role of quality takes place in an environment in which the quality of U.S. export soybeans is already changing. FGIS inspection data from 1986 to 1992 suggest that the overall quality of U.S. soybean exports is improving, though not in terms of FM (table 13). Average levels of FM and split soybeans shipped to countries examined fell slightly or remained fairly stable over the 6-year period, and test weight and moisture content improved steadily in nearly all cases. Actual levels were consistent with contract specifications, which were the grade factor limits in nearly every instance. Calculated standard deviations suggest that the success of efforts to achieve greater uniformity in shipments has been mixed: variability of FM content has increased in five of nine countries between 1986 and 1992, and variability of the percentage of split beans has increased in four of nine cases over the same period (see appendix table 9).

This section summarizes the impact of quality on overall import decisions for the soybean markets featured in this report. Aggregate information available from other research is also provided to supplement information collected from the individual country studies. This section examines the market's relationship with quality: information on exporters' soybean quality efforts provides an indication of their ability to compete with U.S. soybeans on a quality basis, and the discussion on importers' preferences indicates customer soybean quality expectations (both discussed above). An evaluation of U.S. export data allows us to complete the picture of how well U.S. soybeans are able to compete quality-wise.

Quality Patterns in U.S. Soybean Exports

Of the countries examined in this study, most have imported predominantly U.S. No. 2 soybeans over the last 6 years (1986-92). The two exceptions are Indonesia, which imports largely U.S. No. 1 when buying U.S. soybeans for food processing, and Italy, which has shifted from importing mostly U.S. No. 3 soybeans to mostly U.S. No. 2 since 1990 (table 14). According to FGIS export inspection data for these U.S. soybean-importing countries, the measured quality characteristics of most U.S. export soybeans fall within a narrow range (see table 13). With respect to test weight, the averages for these countries over the period examined ranged from 56.7 lbs/bu. to 54.8 lbs/bu., all falling within the test weight limit for U.S. No. 2. Moisture content varied a bit more (from 10.4 percent to 13.4 percent), although most fell

Table 13--Mean quality characteristics of U.S. soybean exports in selected countries at loading, 1986-92

Country	Units	1986	1987	1988	1989	1990	1991	1992
Indonesia:								
Test weight	Lbs/bu	56.32	56.38	56.29	56.52	56.68	55.81	56.56
Moisture	Percent	11.09	11.66	11.05	11.03	10.43	12.37	11.10
FM	Percent	0.95	1.28	1.53	0.48	1.41	1.60	1.16
Splits	Percent	9.0	7.3	11.0	8.2	10.8	6.5	8.7
Italy:[1]								
Test weight	Lbs/bu	55.09	54.77	55.71	55.69	55.81	55.89	55.89
Moisture	Percent	12.93	13.40	11.21	12.1	11.69	12.67	12.40
FM	Percent	2.54	2.43	2.74	2.06	2.63	2.33	1.96
Splits	Percent	10.9	10.4	14.8	8.80	10.9	7.3	8.0
Japan:								
Test weight	lbs/bu	55.76	55.70	56.00	56.14	56.20	56.37	56.10
Moisture	Percent	12.81	12.63	11.79	12.15	11.86	12.22	11.84
FM	Percent	1.78	1.22[2]	1.83	1.87	1.70	1.70	1.70
Splits	Percent	9.2	8.7	10.6	8.5	9.2	7.5	9.2
Mexico:								
Test weight	lbs/bu	55.80	56.47	56.50	55.96	56.11	55.93	56.14
Moisture	Percent	12.35	12.74	11.15	11.57	11.16	11.62	11.14
FM	Percent	1.70	1.66	1.78	1.80	1.78	1.76	1.72
Splits	Percent	10.3	10.6	11.5	10.4	12.6	9.3	10.0
The Netherlands:[1]								
Test weight	lbs/bu	55.44	55.64	55.92	55.81	55.94	56.20	56.25
Moisture	Percent	13.07	12.53	11.81	12.31	12.04	12.14	12.04
FM	Percent	1.90	1.88	1.91	1.96	1.83	1.67	1.70
Splits	Percent	9.0	9.2	10.8	8.9	9.0	7.7	8.2
Russia:[3]								
Test weight	lbs/bu	55.20	55.40	55.57	55.85	55.6	56.21	55.70
Moisture	Percent	12.60	11.97	11.62	12.38	11.30	12.00	11.90
FM	Percent	1.83	1.88	1.69	1.80	1.7	1.76	1.80
Splits	Percent	11.6	9.4	13.5	8.4	13.5	7.3	9.4
South Korea:								
Test weight	lbs/bu	55.94	56.04	56.30	56.17	56.37	56.48	56.30
Moisture	Percent	12.58	12.50	11.45	11.76	11.34	11.92	11.70
FM	Percent	1.76	1.65	1.73	1.76	1.70	1.66	1.56
Splits	Percent	8.8	8.6	10.0	9.0	9.4	7.4	8.2
Spain:								
Test weight	lbs/bu	55.16	55.67	56.03	55.90	55.93	56.07	56.09
Moisture	Percent	13.10	12.56	11.77	12.70	12.06	12.42	12.48
FM	Percent	1.90	1.85	1.91	1.80	1.91	1.76	1.66
Splits	Percent	9.3	9.8	11.4	8.0	10.3	7.6	7.5
Taiwan:								
Test weight	lbs/bu	55.81	55.63	56.16	56.37	56.60	56.40	56.38
Moisture	Percent	12.60	12.48	11.22	11.10	10.87	11.60	11.49
FM[4]	Percent	1.40	1.34	1.50	1.20	1.43	1.39	1.37
Splits	Percent	8.8	10.2	11.5	10.0	10.4	9.0	8.7

Note: No data for Poland included, since no direct shipments of U.S. soybeans to Poland occurred in the period. Data for Venezuela also excluded, for lack of space (see appendix table 8). [1]Excludes 11 shipments of U.S. sample grade soybeans made to Italy between 1986-89 and 3 shipments to the Netherlands in 1989. [2]Many Japanese buyers specified 1-percent FM in 1987. [3]Includes shipments for entire former Soviet Union over the sample period. [4]Represents 1.5-percent FM contract specification.

Source: USDA/FGIS, 1986-92.

Table 14--Share of grades in U.S. soybean exports to selected countries, 1986-92

Country	1986	1987	1988	1989	1990	1991	1992
				Percent			
Indonesia:							
No. 1	100.0	61.0	39.2	51.8	54.7	33.0	70.9
No. 2OB[1]	0.0	39.0	60.8	48.2	45.3	67.0	29.1
Italy:							
No. 2OB	22.7	43.0	2.4	40.9	74.5	85.9	68.9
No. 3OB	71.1	55.1	82.2	53.5	25.5	14.1	31.1
No. 4OW[2]	6.2	1.9	15.4	5.6	0.0	0.0	0.0
Japan:							
No. 1	0.9	1.3	0.7	1.4	2.3	1.4	1.9
No. 2OB	95.4	97.5	93.7	91.1	91.3	96.1	94.9
No. 3OB	1.2	0.6	4.4	6.8	5.9	2.1	3.1
No. 4OW	2.5	0.7	1.2	0.6	0.5	0.3	0.1
Mexico:							
No. 1	2.7	2.1	0.0	0.2	0.0	0.0	0.0
No. 2OB	97.3	97.2	99.6	99.5	97.0	97.7	98.6
No. 3OB	0.0	0.8	0.4	0.0	0.0	0.0	0.1
No. 4OW	0.0	0.0	0.0	0.3	0.0	0.0	0.1
The Netherlands:							
No. 2OB	79.8	89.3	91.9	87.1	93.3	96.2	97.3
No. 3OB	14.7	9.7	8.1	8.4	6.3	3.8	0.0
No. 4OW	5.6	1.0	0.0	4.5	0.4	0.0	2.7
Russia:							
No. 2OB	100.0	100.0	100.0	80.1	100.0	100.0	100.0
No. 4OW	0.0	0.0	0.0	19.9	0.0	0.0	0.0
South Korea:							
No. 1	12.0	14.2	15.8	18.1	14.9	11.2	15.8
No. 2OB	88.0	85.8	84.2	81.9	85.1	88.8	84.2
Spain:							
No. 2OB	86.5	98.4	92.3	91.7	81.7	92.8	91.5
No. 3OB	1.4	1.6	7.7	8.3	18.3	7.2	2.0
No. 4OW	13.1	0.0	0.0	0.0	0.0	0.0	6.5
Taiwan:							
No. 2OB	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Venezuela:							
No. 2OB	100.0	100.0	100.0	100.0	100.0	95.1	100.0
No. 3OB	0.0	0.0	0.0	0.0	0.0.	4.9	0.0

[1]No. 2OB defined as U.S. No. 2 or better. [2]No. 4OW (or worse) includes U.S. No. 4 or better, sample grade, and ungraded shipments.
Source: USDA/FGIS, 1986-92.

between 11.5-12.5 percent. The biggest difference appears with the foreign material factor, with the highest average country-level FM level (Italy, in 1988) more than 200 percent higher than the lowest observed annual average FM (Indonesia, in 1989). Observed averages for split soybean contents ranged from 6.5 percent to 14.8 percent, a 125-percent difference.

The data suggest that importers buying U.S. No. 1 versus U.S. No. 2 soybeans base that decision at least in part on the FM content and to a lesser degree on split soybean content, because other major factors measured by FGIS are relatively stable between grades. From this data set, it is not possible to compare U.S. No. 1 and U.S. No. 2 soybean exports on the basis of protein and oil content. The emphasis on FM and splits as deciding factors is supported by some empirical analysis (Hyberg, Uri, Mercier, and Lyford; Lyford, Yumkella, Mercier, and Hyberg; for a summary of these studies, see appendix B).

Average FM levels in soybean exports from the United States improved for 8 of the 10 countries between 1986 and 1992, although FM content was reduced by less than 3 percent in all but 5 countries (Italy, Japan, the Netherlands, Spain, and South Korea). Only in the case of Italy and the Netherlands can the FM decrease be attributed solely to an overall shift in the dominant grade of U.S. soybeans purchased. For Japan, Mexico, and South Korea, the share of U.S. No. 2 soybeans remained stable. Indonesia's modest shift toward a higher share of U.S. No. 2 from U.S. No. 1 paralleled its increase in average foreign material, although both the share of U.S. No. 2 and average FM fluctuated from year to year. Part of this overall decrease in FM could also be attributed to the adoption of a more stringent Cu-Sum procedure by FGIS in 1990. The new procedure allowed for less variation in FM levels (and other grade-determining factors) between sublots in a given shipment (Lin and others).

Respondents in Taiwan indicated specifying 1.5-percent FM on their import contracts, which is tighter than the U.S. No. 2 grade limit for FM (2.0 percent). Certain Korean food processors also indicated that they would be interested in specifying limits down to 0.5-percent FM on U.S. No. 1 soybeans, but are not able to do so because they have no direct influence over import procurement. Specifications for other grade-determining factors such as damaged kernels or split beans were also included in contracts, but in general, these were not tighter than grade limits. The specifications of the Mexican food agency, CONASUPO, for both foreign material and damaged kernels indicate penalties for levels lower than U.S. No. 2 grade limits, but CONASUPO has purchased few soybeans in recent years. Moisture maximums between 13-14 percent were specified in a few cases.

Implications of U.S. Soybean Export Quality

While levels of foreign material in U.S. soybeans are regarded with some concern by soybean importers, there is only limited evidence that providing cleaner soybeans alone would improve U.S. export competitiveness. Price and marketing factors, and protein and oil content dominate cleanliness in this arena.

Quantity Adjustments

It is not likely that there would be any expansion of U.S. soybean exports in the study countries if cleaner soybeans were offered at the same price, although there is some hope for retaining market share that otherwise might continue to erode. Taiwanese and Japanese soybean users specifically mentioned this possibility. They suggested that all else being equal, delivery of low-FM soybeans could stave off a decline of between 100,000 and 200,000 tons of U.S. soybean exports to those countries (from current combined levels of nearly 6.5 million tons). Japan and Taiwan's share of that potential decline would each be 50,000-100,000 tons.

Price Adjustments

Processors in a few cases indicated an interest in paying a small premium for cleaner beans, notably in Indonesia and Japan, where soybeans for food constitute a large share of imports. Food bean processors in Indonesia indicated a willingness to pay a premium for cleaner beans, having already moved to buying U.S. No. 1 soybeans rather than U.S. No. 2 soybeans in the mid-1980's. The interviews in Indonesia also revealed a willingness to pay a greater premium for even cleaner beans, up to 4 percent of the import price, or about \$10/ton, to reduce FM an additional 1 percent. This shift would require bringing average FM (currently around 1 percent) down to nearly 0 percent, which may not be practical. U.S. exports into the Indonesian food soybean market are rather small at this point, under 100,000 tons over the last several years. In Japan, the suggested premium amounts to about \$0.035/bu for lower-FM beans, and seems to apply to primarily the crush markets. The premium in the food market would be slightly higher, \$0.05-\$0.06/bu. Single processors interviewed in Spain and Venezuela expressed interest in paying premiums for lower-FM beans, but their impact on total trade is likely negligible. Combined, the revenue impact of the potential premium scenarios amounts to between \$4.0 and \$5.0 million, far less than required to offset cleaning costs.[11]

[11]This revenue impact assumes a scenario in which all U.S. soybean exports to Japan currently shipped as U.S. No. 2 are cleaned to contain 1 percent or less foreign material, and all U.S. food soybean exports to Indonesia are cleaned to similar levels, though in 1992, U.S. soybeans exported to Indonesia contained only 1.2-percent FM on average.

Potential Competitor Responses to Cleaner U.S. Beans

Although the incentive to provide cleaner soybeans is somewhat limited, it is conceivable that U.S. traders might believe it necessary to provide cleaner soybeans at the same price to maintain their market share. That possibility was specifically addressed in a few country case studies. Though difficult to quantify, it is important to weigh potential competitor responses to any effort that U.S. traders might make to improve the cleanliness of export soybeans. Brazil (and China, based on limited evidence from Indonesia) already achieve lower levels of FM in their export soybeans. Brazil's inability to export year-round and the fact that Chinese soybeans are not viable soybeans for crushing tend to limit the competitiveness of both sources with U.S. soybeans in certain markets.

Despite the preference expressed for Brazilian soybeans on the world market, their exportable supply is seasonal and limited due to strong domestic crush demand. This is also the case in Argentina, though Argentine soybeans are regarded as inferior to U.S. soybeans in most markets. In addition, limited grain storage facilities, an inadequate transportation system, and high interest rates increase marketing costs and make it difficult for South American soybean producers to maintain exports throughout the year. Comparable FM levels between Brazilian and U.S. beans would leave Brazil's preferred on the basis of other quality factors, notably oil content, but still fall short in terms of year-round availability. Argentine beans do not have a clear-cut quality advantage over U.S. beans, so the Argentines must continue to press to reduce their costs and improve their ability to compete on price in order to maintain its current market share. Ultimately, it matters little what the FM level of U.S. soybeans is during the South American marketing season--if the United States cleans its soybeans to compete, Brazilian and Argentine traders would lower the price in order to move beans.

While opinions on the relative cleanliness of China's beans differ, other factors limit China's ability to compete with U.S. traders across all markets. The characteristics of Chinese soybeans make them more suited for food processing than crushing. The lower protein content of these soybeans renders them less desirable for use in the feed market in many countries. Soymeal from China is competitive in many Asian countries because of China's transportation cost advantage. Soybeans and soybean products are exported from many countries, but only Brazil, Argentina, and China compete widely with the United States across all regions of the world.

Implications

The benefits from matching Brazilian FM levels in soybeans are modest at best, and would be reaped most efficiently by targeting those few markets that can be identified as willing to pay for low-FM U.S. soybeans. Wholesale cleaning of all U.S. export soybeans would not be a cost-effective strategy. Supporting analyses performed on transaction-level soybean prices, trade flows, and quality characteristics were inconclusive as to whether foreign material significantly influences the price paid or the source of imported soybeans in major soybean-importers (Hyberg and others; Bankowska, Jones, and Cacho; Lyford and others). Pursuing strategies based on enhancing soybean genetics, however, could be more lucrative, particularly if the focus is placed on the characteristics which matter most to soybean importers, oil and protein content. The merit of such strategies has mixed support in empirical studies on how importers value these factors.

The United States and Brazil differ in their ability to compete on the basis of these key quality characteristics. Traders of Brazilian beans typically offer protein and oil guarantees to soybean purchasers, while buyers of U.S. beans have to specifically request that protein and oil content be measured and reported on their certificates. A perception exists in many importing countries that oil and protein content of Brazilian soybeans almost always exceeds that of U.S. soybeans. However, a joint USDA/American Soybean Association study in the late 1980's of soybeans arriving in European ports found Brazilian beans outperforming U.S. beans only in oil content (U.S. Congress).[12]

Contract specifications relating to oil or protein levels were revealed in four countries (Taiwan, South Korea, Russia, and Spain), though such specifications are by no means the rule even within those markets. Many importers recommended making oil and protein content grade-determining factors in the U.S. soybean standards. Interestingly, the strongest interest in adding these factors stems from Mexico and Venezuela, where many importers do not now specify oil and protein minimums.

Reporting of oil and protein content by FGIS upon request became available for U.S. soybeans in October 1989. Since that time, the share of U.S. soybean exports for which those factors have been measured has risen, from 46.5 percent of total exports in the last 3 months of 1989 to 58.5 percent in 1992. Shipments of U.S. soybeans imported by the countries examined in this study account for the majority of shipments carrying this information,

[12]The belief that Brazilian soybeans outperform U.S. soybeans in both oil and protein likely stems from the fact that if two beans have identical protein content but one has higher oil content, then the resulting meal from the higher oil bean will have a higher protein concentration, because hulls make up a smaller share of the remainder (Leffel).

although the share of these countries has slipped since 1990, suggesting that other importers are increasingly seeking such information.

Brazil benefits from a system of offering both higher oil soybeans and better information about the intrinsic characteristics (in terms of guarantees) of their commodity. Competing with Brazil on the basis of the oil content of their soybeans would not be an easy task for the U.S. soybean sector. Most of the Brazilian soybean growing area is located in warm climates, and higher average temperature during the growing season has been shown to be positively correlated with higher oil content (Nichols, Clapp, and Perrin).

In selecting for soybean varieties (or cultivars), it is possible for breeders to emphasize the level of oil content, but higher oil content always comes at the expense of protein content, or vice versa (Crowder). The same tradeoff has usually prevailed between yield and protein content. Breeding for protein content would only be profitable if the loss ratio for yield relative to protein gains can be limited to less than 0.6 bushels per acre for each percentage gain in protein content (Iowa Agriculture and Home Economics Experiment Station (IAHEES), 1990). An extensive study found that several modifications of soybeans to provide better quality protein or oil through conventional plant breeding or genetic engineering (such as improved oxidative stability or a higher ratio of monounsaturated to polyunsaturated fatty oils) would create substantial benefits by lowering processing costs. Most of those benefits would accrue to the end-users, although farmers would see some net benefits (IAHEES, 1993; Wilson).[13] *Segregation costs* would likely be higher if efforts to achieve specific oil characteristics in soybean breeding were undertaken.

Farmers would need accurate and reliable information about the availability of financial incentives to be willing to plant high-oil (or high-protein) soybean varieties. In addition, handlers throughout the marketing system would need to preserve the identity of such soybeans in order for them to reach the markets where such soybeans would receive premia. These information demands tie back into the other aspect of the Brazilian oil content advantage, their ability to report such information to buyers. Equipment to measure these factors is already mostly in place for the U.S. marketing system, as modern technology (such as *near-infrared reflectance spectroscopy*) has become available and installed in most FGIS laboratories. In the vast majority of cases, FGIS is able to provide measures of oil and protein for export soybeans upon request, at no additional cost to buyers or sellers. If importers are concerned about protein and oil in the soybeans they purchase, more importers should grasp this opportunity to monitor levels through the FGIS inspection process, and to segregate export soybeans according to oil or protein levels.

Taking the additional step of incorporating these factors into official U.S. standards for soybeans would move U.S. provision and assurance of quality information to what is now available from other major soybean-exporting countries. The pros and cons of such a move have not been evaluated, nor could they be until a suitable match-up of protein and oil levels to the various U.S. grades has been determined. On the supply side, such an action would encourage wider adoption of certain soybean varieties that produce the levels of protein and oil required to meet the revised U.S. No. 2 limits, and discourage use of varieties which do not. It would also tend to penalize farmers accustomed to maximizing yield as their single measure of success. On the demand side, fixing the range of protein and oil contents for the standard U.S. No. 2 soybean could benefit those importers who now pay premia for such guarantees, and cost those importers who have no such interests.

Soybean Market Developments

Other factors and events may have an impact on the role of quality in soybean import decisionmaking in the future. Increasing income levels, particularly in newly industrialized countries such as South Korea and Taiwan and developing countries such as Indonesia, are likely to enhance demand for meat and poultry products, and thus increase feed demand.

Many of these Asian countries already show some concern about the quality of the bean they crush, and with higher incomes, that concern could be translated into demand for higher quality soybeans. Protein-deficient regions like the Former Soviet Union and Eastern Europe are likely to increase their demand for oilseeds and oilseed meals in the medium and long term; but their markets at present are driven more by credit availability and transportation cost advantages than by quality concerns. In addition, Eastern European countries like Poland have entered into association agreements with the EC that gives EC oilseed meal tariff preferences. Limited and somewhat obsolete crushing capacity will continue the Eastern European import preference for products rather than beans. Reliance by these markets on protein meal imports implies an indirect benefit to U.S. soybean producers by

[13]In the U.S. market, some of the benefits to end-users would be captured by soybean producers, since many also use soybean meal to feed hogs and dairy cattle. A large share of the benefits would go to the domestic poultry industry and to users in foreign countries. These suggested modifications include alterations to the amino acid composition of protein in soybeans, and others would alter the fat content of oil in beans, to reduce those fats less desirable for human consumption.

boosting EC soybean imports. Similar tariff preferences and outdated crushing facilities affect Venezuelan importers' purchases.

Policy reforms underway in both the EC and Mexico will influence their importing patterns. CAP reform may slightly reduce EC oilseed and meal imports because of increased use of EC-grown grains. This represents a potential decline in a quality-conscious market. Mexican reduction of trade barriers under the North American Free Trade Agreement (NAFTA) is expected to result in a very modest expansion of imports of soybeans and soybean products, mostly from the United States (USDA/ERS, 1992; Lyford and others).

The successful Uruguay Round of the General Agreement on Tariffs and Trade (GATT) could impact trade in soybean and soybean products. Reduced subsidization of feed grains on the world market could make relative prices of oilseeds and protein meals slightly more attractive, thus modestly enhancing trade. On the other hand, the harmonization of sanitary and phyto-sanitary rules and lower trade barriers on meat and livestock products could increase trade in such value-added goods, possibly reducing the overall demand for imports of feed ingredients, although more likely it would simply alter the location of that feed consumption. Higher income resulting from the GATT agreement should also result in higher overall consumption of agricultural goods, especially meat and livestock goods, which are particularly income-elastic.

Conclusions

Soybean quality is clearly linked to price in determining soybean export market share. The importance of quality varies depending on the market, with importers of soybeans for food emphasizing different aspects of quality than importers of soybeans for feed use. Interviews in the study countries found U.S. soybeans perceived as inferior in quality to Brazilian and Chinese soybeans (the latter is limited to food use), and superior to Argentine soybeans. Governmental intervention has had only a minimal effect on decisionmaking in the world soybean market (both import and export sides), although relatively more import barriers exist for soybean products.

Mandating cleaner soybeans under current production and marketing practices would appear to have only a minor effect on the market share or value of U.S. soybean exports. The world soybean market appears to function fairly well. Based on importers' knowledge of the type and characteristics of soybeans they generally receive what they contract for from various exporters. Importers buy soybeans from Brazil and Argentina in the months after harvest because prices are lower and quality (especially oil content for Brazil) is higher. Many buy U.S. soybeans only when competitor beans are no longer available.

Glossary

Commissao de Financiamento da Producao--The production financing commission, an agency of the Brazilian government which administers soybean production policies.

CONASUPO--Compania Nacional de Subsistencias Populares S.A., which is the Mexican National Basic Food Distribution Agency.

Distillers' dried grain--A byproduct of the alcohol distillation process (yielding grain alcohol and ethanol). It is a feed ingredient preferred in the rations of high-producing dairy cattle, feedlot cattle, and calf starters.

Double-cropping--The growing of two crops consecutively on the same land in the same marketing year. In the United States, this practice is most common in the Southern States, with slightly longer summer growing seasons than is the case in the Midwest. About 10 percent of total U.S. soybean area is double-cropped, most frequently with winter wheat (USDA/NASS, 1993).

Extraction column--An elongated structure in a soybean processing facility in which soybean flakes are mixed with a solvent. The oil contained in the soybean flakes chemically combines with the solvent, which is then strained and carried over for further refining.

Foreign material--All matter that passes through an 8/64-inch sieve, plus material other than soybeans remaining in the sieved sample, according to FGIS definitions.

Free-fatty acids (FFA)--A measure of enzymatic hydrolysis of *triglycerides* indicative of damage to a soybean seed. Excess free-fatty acid content leads to neutral oil losses during soybean oil processing and reduces the product yield.

Full-fat soybeans--Full-fat soybeans are produced by roasting or extruding whole beans in order to kill the *trypsin inhibitor* that is present in raw soybeans (Soule and others). Full-fat soybeans are high in both protein and energy, because the oil component is not removed.

Grade factor or grade determining factor--Those characteristics of grain used to determine the numerical grade. The grade factor is based on quantitative limits (either maximums or minimums) placed on each factor for each grade.

Heat-damaged kernels--Soybeans and pieces of soybeans that are materially discolored or damaged by heat.

Hexane--A colorless, flammable liquid, derived from the fractional distillation of petroleum and used as a solvent in industrial processing.

Identity preservation--Segregation of a commodity from one point to the next in the marketing system. The initially identified commodity is delivered to the next point in the marketing system without being mixed with other units of the same commodity during handling.

Intrinsic value (or end-use value)--Characteristics critical to the end-use of grain. These are nonvisual and can only be determined by analytical tests. For example, the intrinsic quality of soybeans is determined by characteristics such as protein, oil, and FFA content.

IOM soybeans--A trade name for soybeans of a uniform size for food use purchased by Japanese processors. The phrase is derived from Indiana, Ohio, and Michigan, which was the area in which such soybeans were found when such a contract specification was first used a few decades ago.

Miso--A mixture of cooked soybeans, fermented rice starter culture, and salt water, which is fermented for several months. Used as a major ingredient in soup and other Japanese foods.

Moisture content--The amount of water in grain; measured by the weight of water as a percentage of the total weight of the grain including water.

Near-infrared reflectance spectroscopy--A new analytical technique that can determine the composition of materials by examining them with a spectroscope that is designed to operate in the near infra-red region of the spectrum.

Plasticizer--A chemical substance added to a product to keep it soft and pliable.

Quarantine seeds--Seeds which are by law barred from entry into a given country, because they present a potential disease or infestation hazard to indigenous plants, livestock, or human inhabitants.

Sanitary and phyto-sanitary regulations--Rules dealing with the wholesomeness of animal and plant products imported into a given country.

Segregation costs--The costs incurred in maintaining the identity of a particular shipment of a commodity throughout the marketing channel, from farmgate to processor. Includes the cost of measuring its quality characteristics and storing and moving the product separately from the general flow of goods.

Splits (or split beans)--Soybeans with more than one-quarter of the bean removed that are not otherwise damaged.

Tempe (or tempeh)--A fermented whole soybean product popular in Indonesia and Malaysia which is used as a meat replacement in main dishes.

Test weight--Weight per unit volume as measured in pounds per bushel as defined in the United States. Determined by weighing the quantity of grain required to fill a 1-quart container. The international equivalent measure is kilograms per hectoliter (conversion factor 0.77).

Tofu--Bean curd, packaged and marketed as a protein substitute for human consumption. Especially popular in East Asia and vegetarian diets.

Triglycerides--An organic compound of three fatty or monobasic acids (such as palmitic, stearic, and oleic acids) and glycerol.

Trypsin inhibitors--A constituent of uncooked soybean meal which inhibit animal proteases, thus decreasing protein availability and depressing growth in animals.

Yuba--A soy protein film packaged in sheet form, small rolls, or various shapes and sizes for human consumption, primarily in Japan. Derived from soymilk.

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Appendix A: Uses for Soybeans

Processing

The processing (crushing) of soybeans into meal and oil is a fairly standardized technical process worldwide. The soybeans to be crushed are first cleaned to low FM levels as demanded by the processing technique. The crushing process begins when the soybeans are cracked, conditioned with heat, and put through the flaking rolls (U.S. Congress). This procedure removes the hulls, a portion of which can be re-added to the meal at a later stage, depending on whether the processor is preparing 44-percent protein or 48-percent protein soybean meal. The next step involves oil extraction from the flake, which may be done either mechanically or through the use of chemical solvents (mainly *hexane*).[14] The solvent process, which is used by most large facilities, extracts the oil by mixing the flakes and a solvent together in an *extraction column*. The solvent then separates the oil and a pipe removes the solution for collection (the solvent is later separated from the oil).

After the oil is extracted, the flakes are toasted and ground into meal products. During the crushing process, a narrow temperature range must be observed to maintain the nutritional content of the meal. When returning the extracted soybean hulls to the meal, the amount returned depends on the desired protein level of the meal, in relation to the actual protein yield of the bean. In lieu of being added to the meal, soybean hulls are sometimes marketed separately as soybean hull meal and mill feed; the former contains about 20-percent protein.

When processing is completed, the oil and meal are sold to refiners, traders, and manufacturers of consumer or industrial goods. The oil is often further processed (refined) by removing undesirable constituents of crude oil such as free fatty acids, color pigments, water, and nonfatty materials such as gums. Soybean oil is used in consumer products such as cooking oils, margarine, shortening, and salad dressing, and as an intermediate product in processed food. Uses of soybean oil in industrial products include production of paints, *plasticizers*, and fatty acids. Finally, soybean meal is used mainly as a high protein ingredient in prepared feeds for livestock and poultry. A 60-pound bushel of soybeans typically yields 47 pounds of soymeal and 11 pounds of soybean oil when crushed. Soybeans are also cooked whole and fed to animals in some areas, mainly Europe.

[14]The mechanical process extracts the oil through various methods of applying pressure to the flakes. Use of mechanical pressing usually leaves 5-8 percent residual oil in the meal mixture (Ensminger, Oldfield, and Heinemann).

Soybeans for Food

The use of soybeans as a staple food occurs primarily in East Asia where soy products are consumed as meat substitutes. These products include soymilk, products from soymilk such as *tofu,* and soy sauce. The process for creating soy food products usually starts with the grinding of soybean slurry (soybeans soaked overnight in water) into soymilk. This soymilk is then coagulated, molded, and pressed into products such as tofu and other similar products like *yuba.* The food market is only a small share of the world soybean market and is likely to see minimal growth over the next decade, unless vegetarian diets become more popular in the West (Wilson). Consumption for food use will continue to grow at a rate similar to population growth in East Asian countries.

Appendix B: Soybean Export Price-Quality Relationships: A Hedonic Approach

Soybean exports are not a homogeneous product. The oil, protein, FM, damaged kernels, and moisture content of soybeans vary from shipment to shipment, as do other soybean attributes. Economic theory suggests that the prices paid for these soybeans should reflect the differences in key attributes, if the market is functioning efficiently. The contribution of the soybean meal and oil components to the overall price of soybeans may vary as market conditions alter the ratio of the soybean meal to soybean oil price, and may also vary between markets due to different government policies and market structures.

In an efficient market, soybean prices will reflect the differentiation in the characteristics of a specific lot of soybeans. The two studies discussed here look at the price of soybeans exported from two different viewpoints: an overall model of the U.S. soybean export market, and separate models analyzing U.S. soybeans imported by Japan, South Korea, the Netherlands, and other European countries (Lyford and others; Hyberg and others).[15,16] Both studies are designed to determine whether the market for soybeans is behaving as anticipated. Three questions are addressed: (1) Which soybean attributes measured by U.S. grades and standards are relevant? (2) Do export prices reflect the official U.S. grade for soybeans? (3) Does the valuation of soybean characteristics vary between countries which import U.S soybeans?

Data

Both studies used exactly the same data sources for their estimation. Soybean shipment data from the Department of Commerce permits the estimation of the implicit prices for the characteristics of U.S. export soybeans. Price and quantity data used were collected by the Bureau of the Census, while the grade and characteristics of each shipment were collected by FGIS during official inspections. These data contain actual transaction prices and the associated physical characteristics instead of average values for the various variables. Previous studies of implicit prices associated with grain characteristics used average values for prices and grain characteristics. Averages are not appropriate for the estimation of implicit price relationships because aggregation tends to obscure the relationship between physical characteristics and prices leading to estimated implicit prices that do not fully capture the underlying price mechanisms.

A sample of more than 500 shipments of U.S. number 1, 2, and 3 soybeans to Japan, the Netherlands, Korea, the United Kingdom, Belgium, the former West German Republic, Spain, Portugal, and France was obtained. The transactions occurred over the period January 1990 through October 1991, and represent a substantial portion of U.S. soybeans exported over this period. The data were examined to assure that coefficient estimates were not inordinately influenced by a subset of unrepresentative observations. The examination of the Japanese data revealed two separate types of soybean sales to Japan--sales similar to those observed for the other importing countries, and sales characterized by high prices and low volumes. It was determined that the high-valued sales were likely soybeans destined directly for the food market and not for crushing. Because these studies are examining U.S. soybean exports for the crushing market, the observations for soybeans destined for the food market were set aside. Further, the analyses only utilized data observations which contained complete information about measured oil and protein content, which reduced usable observations to about 200.

Variables used in the separate country analysis included month and year of shipment; shipment price and official grade assigned to a shipment; percentage splits, foreign material, and damaged kernels; the processing margin; and the value of the oil and meal per bushel. The processing margins were obtained from the Oil Crops Situation and Outlook Reports (USDA/ERS, 1990-92). The oil and meal values were constructed using oil and meal prices and the crushing yields also obtained from the Oil Crops Situation and Outlook Reports (USDA/ERS, 1990-92).

The overall market model used a somewhat different subset of variables for estimation purposes. The dependent variable was constructed, subtracting shipment

[15]The chief author of the overall model tested for the validity of separable soybean markets, and rejected the hypothesis.

[16]The Hyberg and others study shall be referred to as the Hyberg study, and the Lyford and others study shall be referred to as the Lyford study.

price from a reference price, the average U.S. No. 2 soybean price (Gulf) for the week prior to loading, in order to account for supply and demand shifts over the data period. It used the same basic physical factors as the country-level models: splits, foreign material, and total damaged kernels. This model also incorporated measured values of moisture, protein content and oil content, as well as dummy variables indicating separate marketing years. The quality variables were also corrected to reflect differences in quality from U.S. No. 2 soybeans. The log of the volume of each shipment was also included in the equation.

Estimation

In the separate country modeling system, several functional forms were estimated. A log-linear function for the U.S. export price for soybeans was found to perform best in terms of goodness of fit, coefficient significance, and robust residuals. The price is measured in dollars per metric ton. Because the time period is relatively short, no attempt is made to correct for inflation. Thus, the implicit values of the soybean quality characteristics are in current dollar terms. A variable was retained in the final specification when the coefficient estimate exceeded its standard error. The overall country model was estimated in linear form.

Results

In the Hyberg study, statistical (Chow) tests suggested that the use of separate country models is more appropriate in explaining soybean prices than a single combined model, because the coefficients for soybean characteristic may vary across markets. The Lyford study focused on whether or not implicit values of characteristics may also vary across time.

The official grade given a shipment was nonsignificant in explaining soybean prices in every equation estimated in the two studies. In general, only one grade-determining characteristic had a significant effect on price in each of the models. In the overall model, foreign material was significant. In the model for Japan, the coefficient for split beans was statistically significant. In the Dutch and Korean models, the coefficient for damaged kernels was significant. Moisture content, which is measured but not incorporated in official U.S. grades, had a significant though unexpectedly positive impact on soybean prices in the aggregate model.

In the individual country models, the empirical results indicate that the value of the oil and protein content of soybeans had the expected strong positive effect on soybean prices. Only in the Korean model did the meal value of the shipment fail to enter the model significantly. In all other country models, the coefficients on both the oil value and meal value variables were positive and significant at the 1-percent level. When oil and protein content are considered as separate variables (independent of value), they fail to enter either the aggregate or the year-by-year models at a significant level.

The coefficients for nonquality factors incorporated in the models can be found in appendix tables 1 and 2. For further discussion, see full papers (Lyford and others; Hyberg and others).

There are distinct differences in the approaches and results of the two studies. One study (Lyford and others) found little evidence of incentives in the marketplace for emphasizing oil and protein content, and found the price-quality relationship to be fairly consistent across markets. The other study (Hyberg and others) found that the demand for protein and oil were transmitted and that the price-quality relationship did differ across destinations. The different results may stem from a combination of several factors: (1) different criteria for including observations in analysis, (2) use of soybean prices versus oil and protein prices, and (3) correction for changes from reference price and quality.

Conclusions

A comparison of the soybean pricing models for Japan and the Netherlands illustrates the effect of differential government policies. Processors in both countries use pricing of individual characteristics to compensate sellers for meeting their product needs. The differences in the pricing structure revealed by the estimation results show that government policies in Europe changed the implicit values of various soybean characteristics relative to those for Japan, an importer with more neutral import policies. Specifically, the policies designed to foster the European oilseed industry decreased the value of oil component of soybeans in the Netherlands, relative to the value of the meal component.

In this era of increasing competitiveness, the United States faces the challenge of developing innovative methods to expand and maintain its share of global markets. The provision of high-quality beans could be one such source of competitive advantage. There is no doubt that the United States is capable of providing high-quality soybeans, given its highly developed infrastructure. However, as the results of these studies indicate, the current grading system fails to provide incentives for soybeans with higher protein and oil content and may actually provide an incentive for increased moisture. Although some transactions match desired quality with actual quality supplied, there is a need to refine the price mechanism to more accurately transmit the quality requirements between all buyers and all U.S. producers and exporters.

Appendix table 1--Empirical estimates of the U.S. export price of soybean relationships

Variable	Japan		The Netherlands		Rest of Europe		Republic of Korea	
	Estimate	*Std error*	*Estimate*	*Std error*	*Estimate*	*Std error*	*Estimate*	*Std error*
Intercept	4.132	0.254	4.648	0.329	4.124	0.348	5.241	0.102
Oil value	0.309	0.029	0.112	0.044	0.261	0.059	0.172	0.068
Meal value	0.442	0.113	0.361	0.141	0.453	0.143		
Margin	-0.106	0.018	-0.129	0.029	-0.107	0.026	-0.062	0.023
Splits	-0.060	0.017						
Damaged kernel			-0.050	0.023			-0.070	0.026
Quantity			-0.128	0.005				
Sum								
Foreign material								
Dutch								
French					-0.022	0.014		
Belgian					0.013	0.007		
Apr 90			0.085	0.024				
May 90	0.079	0.016						
Aug 90	-0.035	0.011					0.053	0.031
Sep 90	0.048	0.011						
Oct 90			0.029	0.013				
Feb 91	-0.031	0.011						
Jun 91			-0.023	0.013				
Jul 91							-0.073	0.031
Oct 91	0.046	0.008	0.070	0.014				
Nov 91					-0.022	0.012		
Numbers of observations	59		71		52		31	
Adjusted R^2	0.82		0.55		0.48		0.55	
Sum of squared errors	0.0095		0.0315		0.0157		0.0211	

Source: Hyberg and others.

Appendix table 2--Base regression by marketing year

Variable	Aggregate	1989/90	1990/91	1991/92
Constant	-0.018 (-0.16)	0.120 (0.64)	0.091 (0.68)	-0.346 (-1.07)
Quantity (log)	-0.037* (-2.17)	-0.074* (-2.04)	-0.027 (-1.24)	0.011 (0.21)
Damaged kernels	-0.051 (-1.41)	-0.061 (-0.80)	-0.062 (-1.13)	-0.016 (-0.13)
Foreign material	-0.103* (-1.67)	0.107 (1.61)	-0.093* (-2.15)	-0.151 (-1.57)
Foreign material, 1989/90	0.207* (3.02)			
Splits	0.005 (0.08)	0.084 (0.68)	-0.004 (-0.03)	-0.129 (-0.62)
Protein content	-0.001 (-0.04)	0.038 (0.68)	0.020 (0.43)	-0.125 (-1.13)
Oil content	0.021 (0.47)	-0.064 (-0.73)	-0.016 (-0.22)	0.082 (0.70)
89/90 dummy	0.092 (1.63)			
90/91 dummy	0.092* (2.57)			
Moisture content	0.061* (2.13)	0.005 (0.07)	0.060 (1.14)	0.040 (0.72)
Korea dummy	0.059* (1.72)	0.170* (2.48)	0.010 (0.21)	-0.003 (-0.03)
Japan dummy	0.036 (1.45)	-0.013 (0.26)	0.017 (0.47)	0.158* (2.46)
R^2	0.24	0.23	0.22	0.46
Observations	198	65	98	35

Source: Lyford and others.

Appendix table 3--World production of major oilseeds, 1988/89-1992/93

Country	1988/89	1989/90	1990/91	1991/92	1992/93
			Million metric tons		
Soybeans:					
United States	42.2	52.4	52.4	54.1	59.6
Brazil	23.2	20.3	15.8	19.3	22.3
China	11.7	10.2	11.0	9.7	10.3
Argentina	6.5	10.8	11.5	11.2	11.0
World	95.7	107.4	104.2	106.9	116.7
Rapeseed:					
China	5.0	5.4	6.9	7.4	7.7
EC-12	5.6	5.3	6.2	7.4	6.3
Canada	4.2	3.2	3.3	4.2	3.7
India	4.4	4.1	5.2	5.8	4.9
World	22.6	22.0	25.2	28.4	25.4
Cottonseed:					
China	7.1	6.4	7.7	9.7	7.7
United States	5.5	4.2	5.4	6.3	5.6
FSU-12	5.0	5.1	4.9	4.4	3.7
India	3.7	4.4	3.9	4.0	4.7
World	32.5	30.7	33.5	36.6	31.5
Sunflowerseed:					
FSU-12	6.2	7.1	6.6	5.6	5.7
EC-12	4.0	3.5	4.3	4.0	4.1
Argentina	3.2	3.8	4.2	3.8	3.1
Eastern Europe	2.1	2.3	2.1	2.3	2.6
World	20.3	21.9	22.8	21.5	21.3
Peanut:					
India	9.0	8.1	7.5	7.1	8.9
China	5.7	5.4	6.4	6.3	6.0
United States	1.8	1.8	1.6	2.3	1.9
World	23.2	22.1	22.2	22.1	23.2
All oilseeds[1]	201.6	212.5	216.0	223.7	226.8

[1]Includes lesser amounts of copra, safflower, and palm kernel.
Source: USDA/FAS, Sept. 1994.

Appendix table 4--World vegetable oil trade, 1988/89-1992/93

Country	1988/89	1989/90	1990/91	1991/92	1992/93
			Million metric tons		
Soybean oil:					
EC-12	1.02	1.14	1.17	1.28	1.29
Argentina	1.00	1.03	1.10	1.13	1.32
United States	0.75	0.61	0.35	0.75	0.64
Brazil	0.70	0.87	0.69	0.66	0.68
World	3.71	3.94	3.63	4.14	4.30
Palm oil:					
Malaysia	4.67	5.52	5.43	5.55	5.70
World	6.04	7.31	7.70	7.65	8.35
Sunflowerseed oil:					
Argentina	0.69	0.93	1.16	1.07	1.08
World	2.33	2.69	2.57	2.67	2.21
Rapeseed oil:					
EC-12	1.00	1.02	1.05	0.92	0.69
World	1.80	1.77	1.90	1.99	1.76
Coconut oil:					
World	1.20	1.53	1.58	1.47	1.52
Palm kernel oil:					
World	0.85	0.92	0.88	0.88	0.79
Cottonseed oil:					
World	0.36	0.62	0.55	0.49	0.36
Olive oil:					
World	0.54	0.53	0.72	0.56	0.64
Peanut oil:					
World	0.21	0.29	0.30	0.32	0.20
Total	17.05	19.59	19.83	20.16	20.13

Source: USDA/FAS.

Appendix table 5--Per capita meat and milk consumption for 1975 and 1991

Country	1975				1991			
	Beef	Pork	Poultry	Milk	Beef	Pork	Poultry	Milk
	Kilograms per person							
Egypt	6.4	[1]	3.3	NA	8.6	[1]	4.2	38
Japan	3.7	10.5	6.9	44	9.1	16.7	14.2	67
Mexico	16.6	13.2	5.3	149	21.0	9.4	8.4	118
Russia[2]	26.3	22.2	6.2	353	29.2	22.1	11.4	347
South Korea	2.0	2.5	1.6	NA	5.1	11.8	4.8	NA
Spain	13.2	17.7	17.4	158	12.5	48.0	21.0	177
Taiwan	1.0	19.3	8.2	NA	2.2	36.0	23.0	NA
Venezuela	23.5	5.9	11.5	91	18.5	5.3	16.5	158

NA=not available. [1]Total pork consumption in Egypt is less than 5,000 tons annually. [2]Data for Russia is for FSU-12. Source: USDA/ERS, Aug. 1994.

Appendix table 6--Trade and domestic policies affecting the livestock sector of selected countries

Policy	Country	Commodity
Trade policies:		
Tariff quota	Japan	Beef
Import quota	South Korea	Beef
Export refunds	EC-12	Beef, poultry, dairy, eggs
Variable levies	EC-12	Beef, poultry, pork, dairy, eggs
Domestic policies:		
Government procurement	Japan, Spain	Beef
Support prices	EC, South Korea	Beef, dairy
Production quotas	Japan, EC	Dairy, beef
Consumer subsidies	Mexico, EC	Dairy
Price controls	Venezuela	Dairy
State controls	Russia, Taiwan	Dairy

Source: USDA/ERS, Dec. 1994.

Appendix table 7--Current U.S. soybean grades and grade requirements

Grade	*Minimum* Test weight	*Maximums* Heat damaged kernels	Total damaged kernels	Foreign material	Splits	Soybeans of other colors
U.S. No. 1	56.0	.2	2.0	1.0	10.0	1.0
U.S. No. 2	54.0	.5	3.0	2.0	20.0	2.0
U.S. No. 3	52.0	1.0	5.0	3.0	30.0	5.0
U.S. No. 4	49.0	3.0	8.0	5.0	40.0	10.0

U.S. sample grade:

(a) Does not meet the requirements for U.S. Nos. 1, 2, 3, or 4; or

(b) Contains 8 or more stones which have a aggregate weight in excess of 0.2 percent of the sample weight , 2 or more pieces of glass, 3 or more Crotalaria seed (Crotalaria spp.), 2 or more castor beans (Ricinus communis L.), 4 or more particles of an unknown foreign substance or a commonly recognized harmful of toxic substances, 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1,000 grams of soybeans; or

(c) Have a musty, sour, or commercially objectionable foreign odor (except garlic odor); or

(d) Are heating or otherwise of distinctly low quality.

Appendix table 8--Mean and standard deviation of quality characteristics, Venezuela, 1986-92

Factors	1986	1987	1988	1989	1990	1991	1992
Mean value:							
Test weight	55.79	56.07	56.11	55.70	56.30	56.30	56.12
Moisture	12.60	12.35	11.94	12.18	12.00	11.90	11.85
FM	1.80	1.80	1.86	1.98	1.90	1.85	1.76
Splits	14.3	8.6	10.3	8.6	8.5	7.5	9.3
Standard deviation:							
Test weight	0.71	0.67	0.59	0.40	0.41	0.35	0.49
Moisture	0.32	0.69	1.11	0.60	0.80	0.44	0.44
FM	0.11	0.16	0.12	0.05	0.06	0.29	0.19
Splits	2.4	2.6	3.9	1.7	2.9	1.3	1.9

Note: Spillover from table 13 and appendix table 9.

Appendix table 9--Standard deviation of quality factors of U.S. soybean exports to selected countries, 1986-92

Country	1986	1987	1988	1989	1990	1991	1992
Indonesia:							
Test weight	0.28	0.26	0.85	0.78	0.24	0.64	0.47
Moisture	0.20	0.93	0.42	1.47	0.30	0.14	0.86
FM	0.10	0.13	0.21	1.40	0.45	0.56	0.38
Splits	0.50	3.8	4.8	1.3	2.0	0.50	3.3
Italy:[1]							
Test weight	0.67	0.81	1.04	0.19	0.23	0.87	0.50
Moisture	0.65	0.41	0.13	1.05	0.39	0.45	0.64
FM	0.45	0.54	0.89	0.65	0.48	0.60	0.42
Splits	2.1	3.2	3.4	0.90	2.9	2.7	3.2
Japan:							
Test weight	0.89	0.89	0.88	0.93	0.58	0.63	0.65
Moisture	0.63	0.73	0.99	0.84	0.58	0.63	0.65
FM	0.54	0.48	0.64	1.87	0.93	0.78	0.93
Splits	3.5	3.3	4.2	4.4	4.2	4.6	4.2
Mexico:							
Test weight	0.55	2.37	1.56	0.49	1.14	0.50	0.63
Moisture	0.58	0.94	1.10	0.96	0.83	0.83	1.04
FM	0.25	0.22	0.16	0.16	0.27	0.23	0.28
Splits	2.9	3.1	4.7	2.5	7.7	2.9	3.2
The Netherlands:[1]							
Test weight	0.68	0.78	0.59	0.52	0.56	0.51	0.54
Moisture	0.68	0.89	0.79	0.62	0.62	0.45	0.63
FM	0.33	0.25	0.29	0.47	0.52	0.52	0.44
Splits	3.1	2.9	3.7	2.8	2.8	1.8	2.6
Russia:[2]							
Test weight	0.48	0.56	0.46	0.36	0.40	0.63	0.24
Moisture	0.47	0.47	0.98	0.56	0.48	0.53	0.26
FM	0.10	0.17	0.17	0.17	0.26	0.19	0.10
Splits	1.6	2.9	3.2	1.6	2.6	1.6	0.80
South Korea:							
Test weight	1.26	0.69	0.63	0.55	0.55	0.39	0.37
Moisture	0.71	0.71	0.75	0.76	0.84	0.68	0.64
FM	0.56	0.38	0.45	0.39	0.43	0.42	0.46
Splits	3.7	2.2	3.5	2.0	2.3	2.5	1.8
Spain:							
Test weight	1.08	0.80	0.59	0.59	0.56	0.56	0.64
Moisture	0.64	0.92	1.19	0.67	0.80	0.46	0.79
FM	0.39	0.19	0.23	0.25	0.37	0.37	0.29
Splits	3.7	3.4	5.8	2.3	3.7	2.2	2.7
Taiwan:							
Test weight	0.34	0.69	0.62	0.63	0.60	3.86	0.48
Moisture	0.54	0.62	0.62	0.79	1.04	6.49	0.80
FM	0.18	0.19	0.32	0.43	0.26	1.69	0.23
Splits	2.4	3.1	3.4	3.1	3.3	3.6	2.3

Note: No data for Poland included, since no direct shipments of U.S. soybeans to Poland occurred in the period. Venezuela data found in appendix table 8. [1]Excludes 11 shipments of U.S. sample grade soybeans made between 1986-89 to Italy and 3 shipments to the Netherlands in 1989. [2]Includes shipments for entire former Soviet Union over the sample period.